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NEW ENGLAND BOTANICAL CLUB

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REVISION OF THE GENUS MELAMPODIUM (COMPOSITAE: HELIANTHEAE)[1]

TOD F. STUESSY

Probably every plant collector in Mexico at some time during his travels has come upon large fields of weedy yellow-headed Compositae. More often than not, these herbs belong to the genus *Melampodium.* Such abundance of numbers, however, is not matched at all by our knowledge of the group, and in fact, the only comprehensive treatment of the genus is B. L. Robinson's synopsis published in 1901. Although this study brings together partial synonymy and provides a key for the group, all taxa are not adequately described nor does the key allow for easy and accurate identification. Many of the recent specimens being collected in Mexico and Central America have been extremely difficult if not impossible to identify satisfactorily. This incomplete understanding of relationships within *Melampodium* suggested that a thorough revision should be undertaken.

The present investigation is based on five years of study, including four months of field work and an examination of over 8000 herbarium specimens. The treatment presented here is essentially a straight-forward revision of *Melampodium.* Evolutionary considerations regarding the whole genus have been kept to a minimum as these evaluations have been the subject of a separate paper (Stuessy, 1971a).

[1]Publication No. 795 from the Department of Botany, The Ohio State University, Columbus.

Comments on probable phyletic relationships among selected species, however, are interspersed throughout the text, and data from experimental studies either in progress or already published are brought to bear on the relationships when appropriate. It is realized that many systematic problems still persist within *Melampodium*, but it is hoped that the present study dispels the confusion that has prevailed.

TAXONOMIC HISTORY

The first description of *Melampodium* appeared in Linnaeus' Hortus Cliffortianus (1738) which was the reference cited in the Species Plantarum of 1753. Linnaeus in his Critica Botanica of 1737 (p. 76) clearly indicated that the name he gave to the genus was derived from "*Melampus medicus graecus*." Apparently overlooking this explanation, many later workers (e.g., Gray, 1884; Cockerell, 1905) erroneously have believed the name to come from the Greek words meaning "black-foot."

From the time of Linnaeus' original description of *M. americanum* in 1738, the number of the species described in *Melampodium* has increased to over 88. Difficulties of specific circumscription and synonymy, resulting from the many described taxa, have been surpassed by the more perplexing problems dealing with generic and sectional delimitation. Because discussions have already been published on the history of generic problems associated with *Melampodium* (Stuessy, 1969b, 1970a), the following comments will emphasize the development of attempts to subdivide the genus.

Humboldt, Bonpland, and Kunth (1820) established the first subdivisions of the genus. Based primarily on the genera that were included in synonymy, they designated three groups (here recognized as subgenera) : *Melampodia*, *Dysodia* (Rich. in Pers.) H.B.K., and *Alciniae* (Cav.) H.B.K. No descriptions or comments were added to explain the rationale for the groupings beyond the inclusion of species.

Morphological criteria for the sections later recognized by Candolle (1836) were first stated by Cassini (1829). Cassini recognized the separate genera, *Melampodium, Alcina,* and a new genus, *Zarabellia,* all of which had inner phyllaries tightly enclosing and fused with a single ray achene, but each of which possessed distinctive characters as follows:

Melampodium L. (1) Inner phyllaries each crowned with a large hooded appendage (2) Sterile disc ovaries very large.

Zarabellia Cass. (1) Inner phyllaries with no hood but with two small valve-like processes (2) sterile disc ovaries nearly or completely absent.

Alcina Cav. (1) Inner phyllaries with no hood or valve-like processes and smooth at the sides (2) Sterile disc ovaries nearly or completely absent.

Candolle (1836) put *Zarabellia* and *Alcina* into *Melampodium* but maintained the taxa as three sections based on Cassini's bract differences: *Eumelampodium* DC., *Zarabellia* (Cass.) DC., and *Alcina* (Cav.) DC. Later, Bentham and Hooker (1873) and Hoffmann (1890) did not recognize sections in *Melampodium,* perhaps to stress the morphological unity of the genus (Turner and King, 1962). Baker, treating Brazilian species (1884), suggested two subgenera: *Dysodium* (Rich. in Pers.) H.B.K., and *Unxia* (L.f.) Baker, which were characterized by pedunculate and subsessile heads, respectively. Baillon (1882) departed significantly from previous authors by lumping *Acanthospermum* Schrank and *Lecocarpus* Dcne. into *Melampodium,* and these included genera formed the basis of his two recognized sections: *Acanthospermum* (Schrank) Baillon and *Lecocarpus* (Dcne.) Baillon.

Robinson in his synopsis of *Melampodium* (1901) submerged section *Alcina* (containing the single species, *M. perfoliatum*) into section *Zarabellia.* The two other sections of Candolle were retained on the basis of the hood versus non-hood bract character. Robinson acknowledged the variability of this feature but wrote that (p. 455)

". . . the presence or absence of a hood can usually be determined readily, and the two sections Eumelampodium and Zarabellia may conveniently be retained."

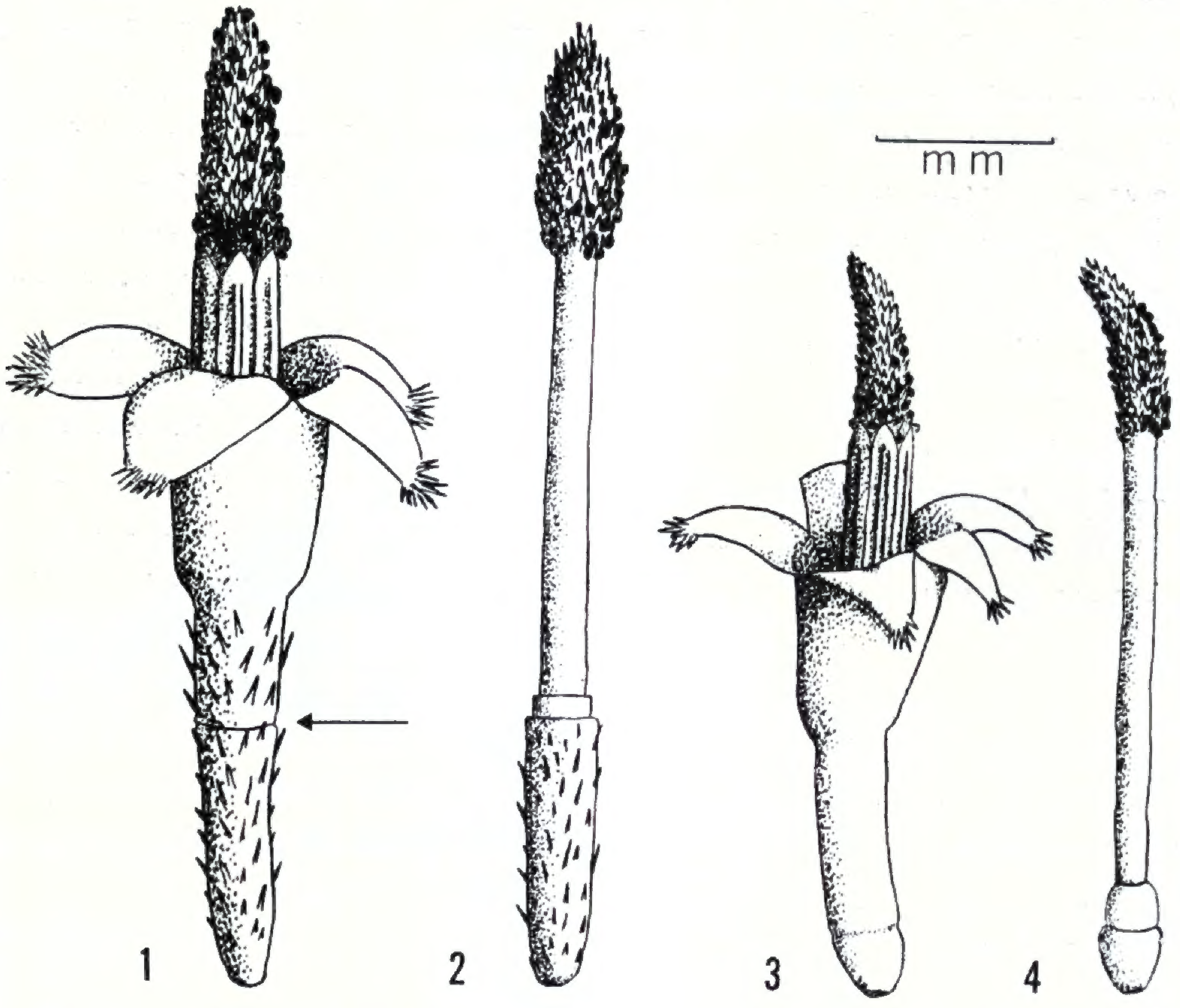
Using cytological data, Turner and King (1962) reopened considerations of sectional subdivision. Based on chromosome counts from 89 populations of 21 species[2], the taxa of section *Melampodium* (*Eumelampodium* DC.) were shown to be on a base of $x = 10$, and the species within section *Zarabellia* to be multibasic with $x = 9, 11, 12, 16$[3] and 23[4]. In addition to bract and chromosome base number criteria, "small plants" and "densely pubescent or tomentose (rarely merely hispid) foliage" were suggested as characterizing section *Melampodium*, with "heterogeneous" morphology and "hispid pubescence" more indicative of section *Zarabellia*.

No one has ever proposed series within the two recognized sections of *Melampodium*. In fact, Robinson experienced frustration in attempting to create such order (1901, p. 455): "Much difficulty has been experienced in giving the species a natural sequence, and after many efforts the hope of securing such an arrangement has been abandoned." Turner and King (1962) suggested that within the more morphologically heterogeneous section *Zarabellia* some formal subdivisions might be desirable after further study. They mentioned several informal groups such as: (1) "the small-headed, annual species having a chromosome base of $x = 9$"; (2) "those rhizomatous species centering about *M. montanum* with chromosome numbers on a base of $x = 11$"; and (3) "those annual species with large involucral bracts and smooth achenes having chromosome numbers of $n = 11$ and 12."

[2]See Stuessy (1971b) for a reassignment of these chromosome counts to the presently recognized taxa.

[3]Due to the generic transfer of *M. camphoratum* ($n = 16$) back into *Unxia* (Stuessy, 1969b), this number no longer belongs in *Melampodium*.

[4]Because of recent counts of $n = 12$ for *M. dicoelocarpum* (Stuessy, 1971b), the $n = 23$ count for this species seems best interpreted as an aneuploid at the tetraploid level on a base of $x = 12$.



Figs. 1-4. Disc florets of representative species of *Melampodium* showing the two different types of abortive ovaries. Figs. 1 & 2, *M. leucanthum, Stuessy* 752 (OS); Figs. 3 & 4, *M. divaricatum, Stuessy* 547 (OS). Drawn from fresh material. The corollas and stamens in Figs. 2 and 4 have been removed, but they are the same florets as in Figs. 1 and 3, respectively. The arrow in Fig. 1 points to a marked annular constriction at the point of ovary and corolla tube juncture, which is characteristic of species in sect. *Melampodium.* That same marked constriction is absent from the florets of species in the other five sections of the genus (Fig. 3). Both types of ovaries are capped by ovarian discs (Figs. 2 & 4).

In the present treatment I depart significantly from previous workers by recognizing six sections in the genus. Based on coherence of morphology and chromosome numbers, section *Melampodium* seems a phyletic unit and therefore is retained, although here for the first time it is divided into five series. Section *Zarabellia s.l.* of previous authors, however, has been circumscribed in the past by

the *absence* of hoods of the inner phyllaries (to be discussed in detail later) and by the possession of chromosome numbers *other than* on a base of $x = 10$ (i.e., $x = 9$, 11, and 12). The only positive feature shared by all taxa of the section is the rudimentary ovary of the disc florets which contrasts markedly with the more conspicuous ovary of those taxa in section *Melampodium* (Figs. 1-4; these ovary differences mentioned earlier by Cassini, 1829, as having generic significance). The diversity of other morphological features and chromosome numbers in taxa of section *Zarabellia s.l.*, however, suggests that the one unifying ovary feature may have been derived by parallel evolution (Stuessy, 1971a). From this phyletic viewpoint section *Zarabellia s.l.* seems an artificial unit and is therefore divided into five separate sections based on chromosomal and morphological differences. Two of the sections, *Zarabellia s.str.* and *Rhizomaria*, correspond respectively to the first two informal groups mentioned by Turner and King (1962). A list of the recognized sections, series, and included taxa follows:

Synopsis of Classification of *Melampodium* L.

I. Section Melampodium
   1. Series Melampodium
      1. *M. americanum* L. 2. *M. diffusum* Cass. 3. *M. pilosum* Stuessy 4. *M. longipes* (A. Gray) Robins. 5. *M. linearilobum* DC.
   2. Series Leucantha Stuessy
      6. *M. leucanthum* Torr. & A. Gray 7. *M. cinereum* DC. 7a. *M. cinereum* DC. var. *cinereum* 7b. *M. cinereum* DC. var. *hirtellum* Stuessy 7c. *M. cinereum* DC. var. *ramosissimum* (DC.) A. Gray 8. *M. argophyllum* (A. Gray ex Robins.) Blake
   3. Series Sericea Stuessy
      9. *M. sericeum* Lag. 10. *M. pringlei* Robins. 11. *M. strigosum* Stuessy 12. *M. longicorne* A. Gray 13. *M. nayaritense* Stuessy

4. Series Cupulata Stuessy
   14. *M. cupulatum* A. Gray 15. *M. appendiculatum* Robins. 16. *M. sinuatum* Brandg. 17. *M. rosei* Robins. 18. *M. tenellum* Hook. & Arn. 19. *M. glabribracteatum* Stuessy
5. Series Longipila Stuessy
   20. *M. longipilum* Robins.

II. Section Zarabellia (Cass.) DC.
   21. *M. longifolium* Cerv. ex Cav. 22. *M. mimulifolium* Robins. 23. *M. gracile* Less. 24. *M. microcephalum* Less. 25. *M. paniculatum* Gardn.

III. Section Serratura Stuessy
   26. *M. divaricatum* (Rich. in Pers.) DC. 27. *M. costaricense* Stuessy 28. *M. dicoelocarpum* Robins. 29. *M. tepicense* Robins. 30. *M. sinaloense* Stuessy

IV. Section Bibractiaria Stuessy
   31. *M. bibracteatum* S. Wats. 32. *M. repens* Sessé & Moc.

V. Section Rhizomaria Stuessy
   33. *M. montanum* Benth. 33a. *M. montanum* Benth. var. *montanum* 33b. *M. montanum* Benth. var. *viridulum* Stuessy 34. *M. aureum* Brandg.

VI. Section Alcina (Cav.) DC.
   35. *M. perfoliatum* (Cav.) H.B.K. 36. *M. glabrum* S. Wats. 37. *M. nutans* Stuessy

DISTRIBUTIONAL SUMMARY

Melampodium is a tropical and subtropical genus mostly restricted to Mexico and Central America (Fig. 5) with four species located in the southwestern United States, and three species scattered in Colombia and Brazil. Although the Brazilian distributions could indicate South American origins for the two species, *M. paniculatum* and *M. divaricatum*, the fact that these species are found abundantly also in Central America and Mexico suggests that their presence in Brazil is due to recent introductions by man.

Fig. 5. Map of North and South America showing generalized distribution of *Melampodium*. Collections from Burma and the Philippine Islands not shown.

The exceedingly weedy nature of *M. divaricatum* and *M. perfoliatum* has allowed successful introductions of the genus to Burma, Cuba, Puerto Rico and the Virgin Islands. Another Mexican species, *M. diffusum*, has become established near Manila in the Philippine Islands.

Melampodium occupies primarily moist habitats from mountain pine-oak to tropical deciduous forests. Only two species, *M. leucanthum* and *M. cinereum*, are clearly xeromorphic, found in the drier regions of northern Mexico and adjacent United States.

SPECIFIC AND VARIETAL CATEGORIES

It would be a formidable task to treat 37 species of a genus exhaustively with many experimental approaches to discover all the effective isolating mechanisms. As a result, in the present study a morphological species concept has been stressed. With the exception of chromosome numbers for many taxa, only in a few cases have data from experimental work been used to define more accurately the reproductive limits of each taxon. It is assumed, however, that the qualitative and quantitative morphological discontinuities formally recognized in this study do represent genetic differences that in some fashion are responsible for maintaining the integrity of each specific and varietal unit.

An attempt has been made to treat specific and varietal categories consistently with regard to the data available in each case. Varieties are regarded as morpho-geographical subdivisions of a species (Kapadia, 1964) that presumably reflect genetic differences.

MORPHOLOGY AND TAXONOMIC CRITERIA

As an aid to understanding the specific and varietal categories used in the present study, the taxonomic value of various morphological features is discussed below:

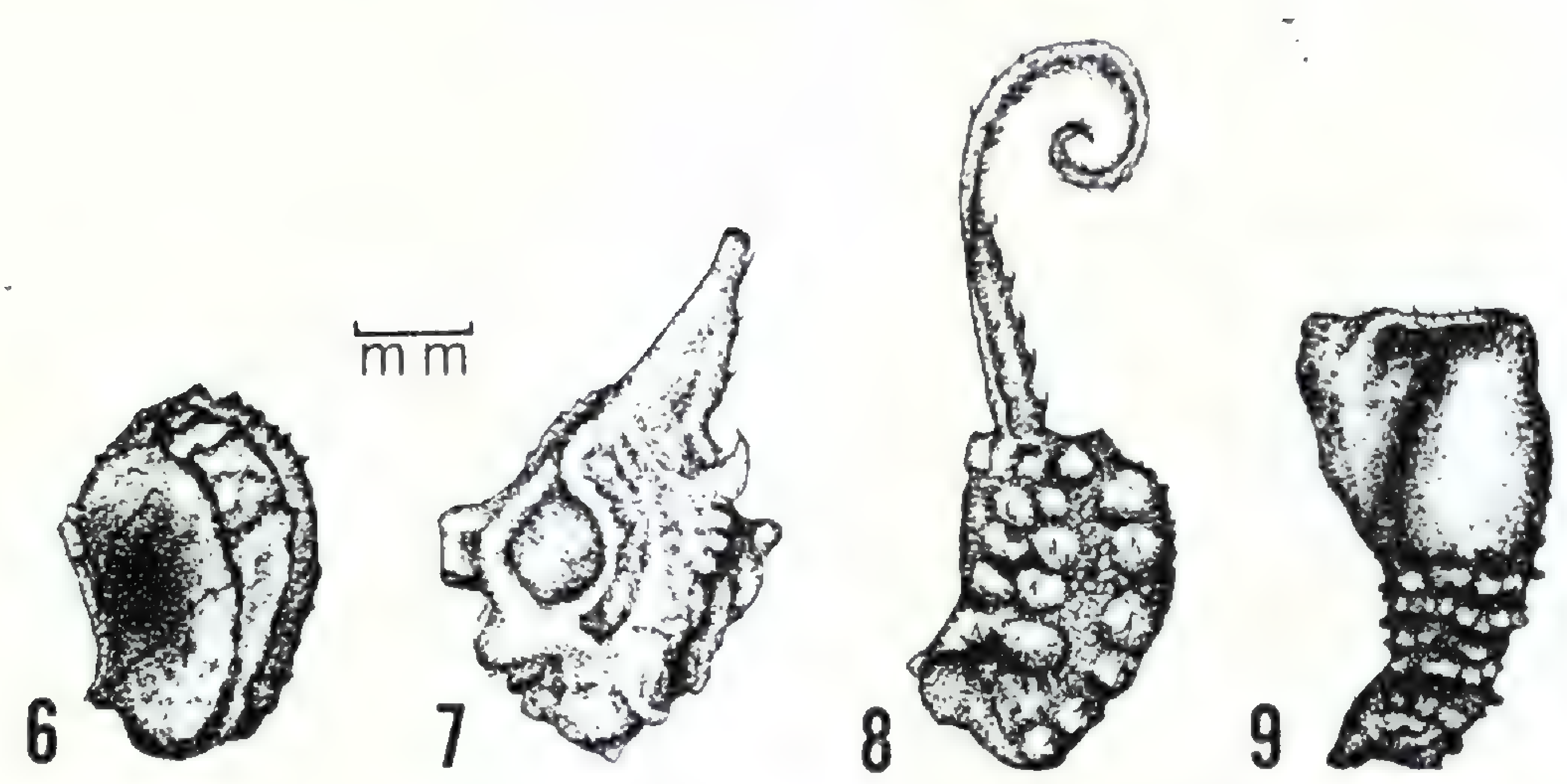
Habit. — Both herbaceous annuals and suffruticose or rhizomatous perennials are found in the genus. The perennial habit is the less common condition found only in the following seven species of sections *Melampodium* and *Rhizomaria*: *M. americanum, M. leucanthum, M. cinereum, M. argophyllum, M. sinuatum, M. montanum*, and *M. aureum*.

Roots. — All taxa of the genus are tap-rooted except for the two rhizomatous perennial species of section *Rhizomaria*: *M. montanum* and *M. aureum*.

Leaves. — The shape, size, vesture, and type of margin of leaves are often useful as discriminating taxonomic characters at various levels in the hierarchy from section to variety. However, in some taxa leaf shape and size can be quite variable, especially in the widespread species, and this plasticity has been the cause of recognition of forms as species or varieties by previous workers (e.g., in *M. divaricatum*).

Vesture. — The surface of various organs ranges from glabrous to copiously sericeous, and the vesture often can be used as a reliable taxonomic character.

Heads. — Many features of the outer and inner involucral bracts and the ray florets are of diagnostic value. Within limits, the number of disc and ray florets is sometimes useful as a specific indicator, and as mentioned previously, the shape of the abortive ovaries of the disc florets is useful as a criterion for delimiting section *Melampodium*. "Fruit" in this treatment refers to the mature ray achene and enveloping inner involucral bract (Robinson, 1901). The fruits are often capped by extensions of the inner involucral bracts of varying shapes and sizes upward from the achene apexes (Figs. 6-9). The presence of one particular type of extension called a "hood" (the term apparently first used by Cassini, 1829, and followed by most subsequent authors) correlates well with other features of section *Melampodium*. Within most species, however, the hood size, shape, and appendage vary considerably. In fact, the amount of variation prevalent among fruits in different plants of a single population (Fig. 10) and sometimes even among bracts in a single head (cf. Fig. 9E in Stuessy, 1970b) is astonishing. Such permutations, especially in the sculpturing of the lateral outer surfaces of the inner phyllaries, have been judged by some students of the group (e.g., Robinson, 1901) as indicative of varieties or even as distinct species. However, with few exceptions (such as in *M. divaricatum* and *M. dicoelocarpum*) the lateral bract surface features usually are not reliable as taxonomic characters.



Figs. 6-9. Representative fruits of *Melampodium* illustrating variation in achenal apexes. Fig. 6, *M. glabrum*, apex moderately sculptured, *Stuessy* 709 (OS); Fig. 7, *M. longifolium*, apex with abaxial protuberance, *Sprengel* s.n. (P); Fig. 8, *M. longipilum*, apex with adaxial awn, *Stuessy* 634 (OS); Fig. 9, *M. leucanthum*, apex with hood, *Stuessy* 752 (OS).

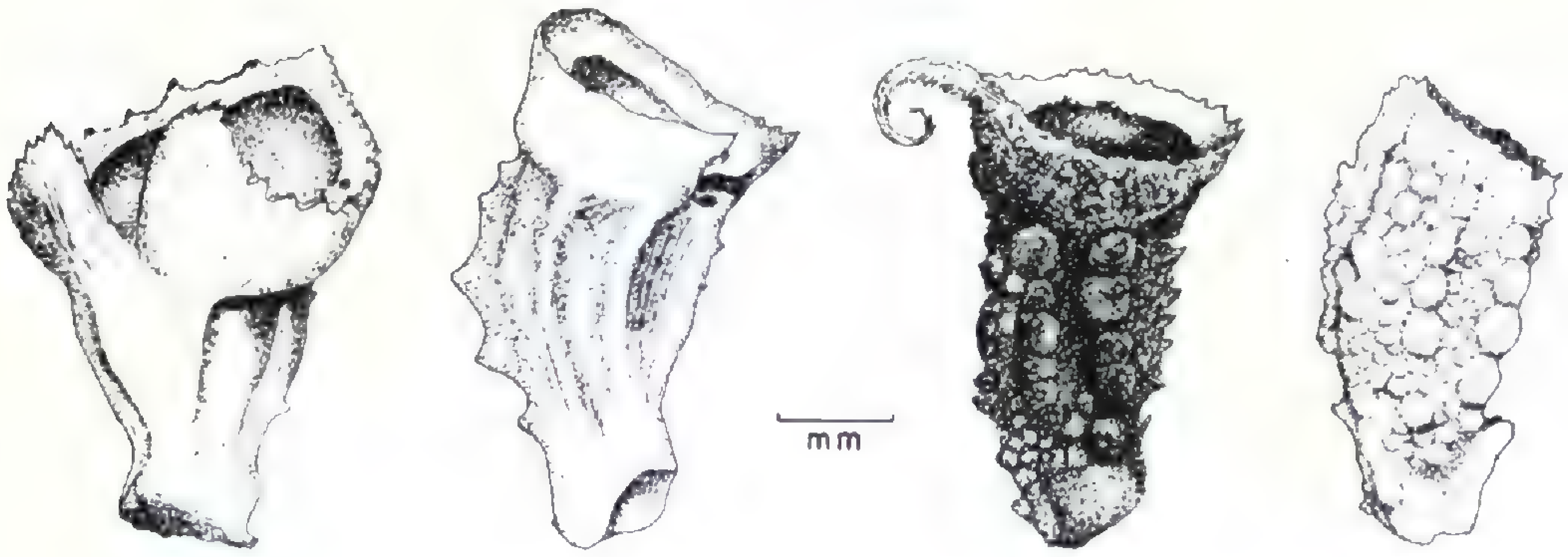


Fig. 10. Representative fruits of *Melampodium linearilobum* from a single population in Michoacán, Mexico (*Stuessy* 698, OS) illustrating variations in structure of the inner involucral bracts.

TAXONOMIC TREATMENT

MELAMPODIUM L.

Melampodium L. [Hort. Cliff. 425. 1738.] Sp. Pl. 921. 1753. Gen. Pl. ed. 5. 392. 1754. Type species: *Melampodium americanum* L.

Cargilla Adans. Fam. 2:130. 1763. *nom. superfl.* including *Chrysogonum* L. and *Melampodium* L.

Alcina Cav. Ic. 1:10. *t. 15.* 1791. Type species: *Alcina perfoliata* Cav. = *Melampodium perfoliatum* (Cav.) H.B.K.

Dysodium Rich. in Pers. Syn. 2:489. 1807. *non Dyssodia* Cav. 1802. Type species: *Dysodium divaricatum* Rich. in Pers. = *Melampodium divaricatum* (Rich. in Pers.) DC.

Melampodium L. subg. *Alcina* (Cav.) H.B.K. [as subg. *Alciniae*]. Nov. Gen. Sp. 4:274. 1820.

Melampodium L. subg. *Dysodium* (Rich. in Pers.) H.B.K. [as subg. *Dysodia*]. Nov. Gen. Sp. 4:273. 1820.

Melampodium L. subg. *Melampodium* [as subg. *Melampodia*]. H.B.K. Nov. Gen. Sp. 4:272. 1820.

Camutia Bonat. ex Steud. Nom. Bot. 146. 1821. *pro syn., nom. nud.* Based on *Camutia perfoliata* Bonat. ex Steud. *Carnutia* [attributed to Bonat. ex Steud. by] Baker in Martius, Fl. Bras. 6(3):159. 1884. *Orthogr. var.*

Zarabellia Cass. Dict. Sc. Nat. 59:240. 1829. [*non* Neck. 1790. invalid *fide* Art. 20, Intern. Code Bot. Nomen.] Type species: *Zarabellia rhomboidea* Cass. = *Melampodium longifolium* Cerv. ex Cav.

Annual herbs to perennial subshrubs. Tap roots in all but 2 species (*M. aureum* and *M. montanum* with fibrous roots and rhizomes). Stems decumbent to erect, terete to finely striate, dichotomously branched with peduncles arising from the middle and upper dichotomies. Peduncles very short and stout to long and filiform. Leaves opposite, decussate, linear to ovate-rhombic, at apex acuminate to obtuse, at base attenuate to auriculate-connate, with upper surfaces glabrous to pilose, with lower surfaces glabrous to sericeous, at margin entire to toothed. Heads solitary. Receptacle paleaceous, convex, sometimes elevated on a short cylindrical stalk 2-3 mm above the outer involucre.

Involucre biseriate. Outer involucre spreading to cupulate; bracts 2-5, more or less equal, with margins entire, separate to connate more than 2/3 their length, with adaxial surface glabrous. Innermost phyllaries each enclosing a single ray achene, completely covering or sometimes partially open at apex, often extending upward into a hood or other apical appendage (Figs. 6-9). Ray florets 3-13; ligules varying shades of yellow or cream-white (2 species), at the apex bi- or tri-dentate, attached on adaxial side of achene apex; tube nonexistent or very short; style branches filiform, flattened, obtuse at the apex, with stigmatic surfaces marginal and enlarged and running the length of the branches, recurved when fruit maturing; achenes asymmetrically obovoid and laterally compressed. Disc florets 3-110; corollas yellow-green to yellow-orange, regular, 5-lobed (rarely 4-lobed), with lobes partially reflexed or extended at right angles, throat salverform-funnelform; anthers brown, exserted from corolla 1/3-1/2 their length; style linear-capillaceous, unbranched, exserted from within anthers; ovary sterile, capped by a disc; pappus absent. Paleae scarious, conduplicate around disc corollas. Chromosome numbers, $n =$ 9, 10, 11, 12, 18, 20, 23, 25 $\pm$ 1, 27, 30, and 33.

ARTIFICIAL KEY TO TAXA

a. Ligules white. (b)

b. Outer phyllaries connate more than half their length. (c)

c. Stems and leaves strigillose; leaves with margins usually entire-sinuate (less often pinnately lobed); heads 20-37 mm diam[5]; ligules 7-13 mm long, 2.5-8 mm wide; plants 15-50 cm tall .... 6. *M. leucanthum*

c. Stems and leaves canescent-tomentose; leaves with margins usually pinnately lobed-parted (less often entire); heads 10-23 mm diam; ligules 2.5-9 mm long, 1.5-4.5 mm wide; plants 12-22 cm tall .... 8. *M. argophyllum*

[5]In the keys and descriptions head diameter excludes the outer involucral bracts.

b. Outer phyllaries connate a third or less their length. (d)
  d. Leaves with basal margins hispid with hairs 0.6-1.5 mm long; stems strigose-hispid with hairs 0.2-1.5 mm long . 7b. *M. cinereum* var. *hirtellum*
  d. Leaves with basal margins strigose with hairs 0.3-0.6 mm long; stems strigose with hairs 0.1-0.8 mm long. (e)
    e. Leaves linear, 7-32 mm long, 2-5 mm broad; heads 3-5 mm tall; outer involucre 4.5-9 mm diam; outer phyllaries 2.7-4 mm long, 1.3-2.8 mm wide; hood 0.8-1.5 mm tall .... 7c. *M. cinereum* var. *ramosissimum*
    e. Leaves linear-oblong, 12-55 mm long, 1-14 mm broad; heads 5-8 mm tall; outer involucre 7-14.3 mm diam; outer phyllaries 3.5-7.3 mm long, 2.3-5 mm wide; hood 1.3-2.9 mm tall .. .. 7a. *M. cinereum* var. *cinereum*

a. Ligules yellow. (f)
  f. Outer phyllaries 2. (g)
    g. Leaves oblong to obovate-oblanceolate; ray florets 5-6 (rarely 3); stems erect to decumbent; plants subaquatic .... 31. *M. bibracteatum*
    g. Leaves obovate; ray florets 2-3; stems prostrate; plants terrestrial .... 32. *M. repens*
  f. Outer phyllaries 3-5. (h)
    h. Outer phyllaries 3. (i)
      i. Heads 3-5.5 mm diam; ligules usually less than 2 mm long; peduncles copiously stipitate-glandular .... 25. *M. paniculatum*
      i. Heads 5-15 mm diam; ligules usually more than 2 mm long; peduncles strigillose to hispid to weakly stipitate-glandular. (j)
        j. Leaves subauriculate at base .... 23. *M. gracile*
        j. Leaves attenuate to obtuse at base. (k)
          k. Leaves with tapering petioles 1-3 cm long; inner phyllaries open in a small

hood at achene apex, often extended into awn . ... 37. *M. nutans*

k. Leaves sessile or with petioles 0.1-0.4 cm long; inner phyllaries completely closed over achene apex, with no extended appendage .... 24. *M. microcephalum*

h. Outer phyllaries 5. (l)

l. Leaves sericeous beneath. (m)

m. Outer phyllaries with the margin scarious .... 5. *M. linearilobum*

m. Outer phyllaries with the margin herbaceous. (n)

n. Leaves narrowly ovate to lanceolate. (o)

o. Plants perennial; heads 11-17 mm diam; ligules 4-6 mm long .... 1. *M. americanum*

o. Plants annual; heads 6-11 mm diam; ligules 2.5-4.5 mm long. (p)

p. Plants 8-28 cm tall; stems pilose; outer phyllaries ovate to narrowly ovate; leaves copiously sericeous beneath .... 3. *M. pilosum*

p. Plants 25-40 cm tall; stems strigillose-hispidulous; outer phyllaries ovate; leaves moderately sericeous beneath .... 2. *M. diffusum*

n. Leaves linear, oblanceolate, or deeply pinnately divided. (q)

q. Ligules 2 mm long or less. (r)

r. Leaves linear and entire to deeply pinnately divided; ligules ca 2 mm long; heads 8-11 mm diam; disc florets 15-25 .... 13. *M. nayaritense*

r. Leaves linear-oblong to oblanceolate, often lobed or parted; ligules ca 1 mm long; heads 4-8 mm diam; disc florets 2-12. (s)

s. Peduncles 5-22 mm long; disc florets 5-12; ligules on undersurface yellow at apex; outer involucre 6-11 mm diam . . 9. *M. sericeum*

s. Peduncles 1-2 mm long; disc florets 2-3; ligules on undersurface purple at apex; outer involucre 3-4 mm diam . . . . 10. *M. pringlei*

q. Ligules more than 2 mm long. (t)

t. Plants annual; stems yellow to green . . . . 4. *M. longipes*

t. Plants perennial; stems purple to green . . . . 1. *M. americanum*

l. Leaves glabrous or strigose beneath. (u)

u. Outer phyllaries with the margin narrowly scarious. (v)

v. Peduncles 1.3-1.7 cm long; outer phyllaries abaxially glabrous . . . . 19. *M. glabribracteatum*

v. Peduncles usually more than 2 cm long; outer phyllaries abaxially subglabrous, strigose or pilose. (w)

w. Plants perennial with fibrous roots and rhizomes. (x)

x. Heads 19-38 mm diam; ligules yellow-orange to yellow, 5-13 mm long; disc corollas yellow; fruit 2-2.3 mm long[6]; chromo-

[6]Fruit length in the key and descriptions excludes hoods and appendages.

some number, $n = 33$ . . . . 34. *M. aureum*

x. Heads 11-21 mm diam; ligules yellow, 4-7.5 mm long; disc corollas yellow-green; fruit 1.6-1.8 mm long; chromosome number, $n = 11$. (y)

y. Ligules on undersurface light green at apex and on veins . . 33b. *M. montanum* var. *viridulum*

y. Ligules on undersurface dark purple at apex and on veins . . 33a. *M. montanum* var. *montanum*

w. Plants annual or perennial with tap roots. (z)

z. Plants perennial; leaves on undersurface copiously tomentose, at margin markedly sinuate . . . . 16. *M. sinuatum*

z. Plants annual; leaves on undersurface strigose, at margin entire, lobed or divided. (aa)

aa. Leaves at base attenuate. (bb)

bb. Outer phyllaries ovate to narrowly ovate, 4-6 mm long; heads 7-8 mm tall . . . . 14. *M. cupulatum*

bb. Outer phyllaries ovate to orbiculate, 2.5-3.5 mm long; heads 3.5-5.5 mm tall . . . . 18. *M. tenellum*

aa. Leaves at base obtuse to subauriculate. (cc)

cc. Outer phyllaries connate 2/3 their length . . . .

.. 15. *M. appendiculatum*

cc. Outer phyllaries connate less than 1/4 their length .... 17. *M. rosei*

u. Outer phyllaries with the margin herbaceous. (dd)

dd. Outer involucre 15-32 mm diam; outer phyllaries 6-20 mm long; fruits 4-7 mm long; lower leaves conspicuously perfoliate at base .... 35. *M. perfoliatum*

dd. Outer involucre 3-10 (–14) mm diam; outer phyllaries 2-6(–6.8) mm long; fruits 1.6-3(–4) mm long; lower leaves attenuate to subauriculate at base. (ee)

ee. Leaves markedly petiolate. (ff)

ff. Ligules 3.5-7 mm long. (gg)

gg. Fruit at apex with a flattened adaxial appendage extending upward into a cirrhous awn (Fig. 8) .... 20. *M. longipilum*

gg. Fruit at apex variously ridged and sculptured but not as above ...... 26. *M. divaricatum*

ff. Ligules less than 3 mm long. (hh)

hh. Fruit on lateral surfaces with 2 deep oval cavities .... 28. *M. dicoelocarpum*

hh. Fruit on lateral surfaces variously ribbed, tubercled, and sculptured but not as above. (ii)

ii. Heads 6-10 mm diam; stems usually 2-4 mm diam .... 27. *M. costaricense*

ii. Heads 3-5 mm diam; stems usually less than 2 mm diam. (jj)

jj. Peduncles 0.8-8 mm long;

disc florets 3-7(–12) . . . . .
. . . . 29. *M. tepicense*

jj. Peduncles 10-29 mm long; disc florets ca 14 . . . .
. . . . 30. *M. sinaloense*

ee. Leaves sessile or subsessile. (kk)

kk. Plants subaquatic; stems thick and yellowish . . . . 36. *M. glabrum*

kk. Plants terrestrial; stems greenish to greenish-purple. (ll)

ll. Ligules less than 2 mm long; outer phyllaries lanceolate. (mm)

mm. Fruits with an abaxial protuberance (Fig. 7) . . . . . .
. . . . 21. *M. longifolium*

mm. Fruits with hoods (Fig. 9) or minutely sculptured at apex. (nn)

nn. Plants usually 15-20 cm tall; stems ascending; peduncles usually 0-3 mm long; leaves at margin entire-pinnately lobed; heads 3-4 mm tall, 4-8 mm diam; outer phyllaries lanceolate-elliptic .
. . . . 11. *M. strigosum*

nn. Plants usually 20-40 cm tall; stems erect; peduncles usually 10-20 mm long; leaves at margin entire to dentate; heads 4-7 mm tall, 7-13 mm diam; outer phyllaries elliptic to obovate-rhombic . . . .
. . . . . . 12. *M. longicorne*

ll. Ligules more than 2 mm long;

outer phyllaries ovate or narrowly ovate. (oo)

oo. Leaves attenuate at base . . . . 24. *M. microcephalum*

oo. Leaves subauriculate to obtuse at base. (pp)

pp. Stems copiously pilose near apex; outer phyllaries ovate-lanceolate, 5-6 mm long, at apex acute . . . . . . 22. *M. mimulifolium*

pp. Stems moderately hispid-pilose and weakly stipitate-glandular near apex; outer phyllaries ovate, 3.5-5 mm long, at apex acuminate . . . . 23. *M. gracile*

I. MELAMPODIUM section Melampodium

Melampodium L. sect. *Eumelampodium* DC. Prodr. 5:518. 1836. Type species: *Melampodium americanum* L.

Tap-rooted annuals or perennials; leaves linear to ovate, sessile to markedly petiolate, with margins entire or lobed or obscurely serrate; outer involucre cupulate, with bracts 5, at margins herbaceous or scarious; ovaries of the disc florets linear, 1.2-2.3 mm long; tube of disc florets with a marked basal annular constriction at point of ovary juncture (Fig. 1, arrow); fruits usually capped (Fig. 9) with a hood (absent in *M. pringlei,* and *M. sinuatum*; sometimes absent in *M. americanum, M. hispidum, M. longicorne,* and *M. sericeum*; rudimentary in *M. cupulatum*) or with a flattended adaxial awn (*M. longipilum,* Fig. 8); chromosome base number, $x = 10$. Species 1-20.

1. Series MELAMPODIUM

Annual herbs or suffruticose perennials (in *M. americanum*); leaves narrowly ovate to linear, often pinnately divided, sericeous beneath, ligules orange-yellow, more than

or rarely about 2 mm long; margins of outer phyllaries herbaceous or scarious (in *M. linearilobum*); fruits usually hooded. Species 1-5. Type species: *Melampodium americanum* L.

1. **Melampodium americanum** L. [Hort. Cliff. 425. 1738.] Sp. Pl. 921. 1753. TYPE: MEXICO: Veracruz, near Veracruz, Mar 1731, *W. Houstoun* s.n. (Holotype, BM; photograph of holotype, NY! US!; photograph of BM isotype, US!).

Calendula decumbens Mill. Gard. Dict. ed. 8. n. 9. 1768. *nom. superfl.*, based on type of *Melampodium americanum*.

Melampolium heterophyllum Lag. Gen. et Sp. Nov. 33. 1816. TYPE: "NOVA HISPANIA": grown in Roy. Bot. Gard. Madrid, source and collector of seeds uncertain (Holotype, MA?; tracing of DC isotype [?], GH!).

Melampodium sericeum H.B.K. Nov. Gen. Sp. 4: 272, *t. 398*. 1820. *non* Lag. 1816. *nom. illegit.* TYPE: MEXICO: Guerrero, between Tehuilotepec and Taxco, 5520 ft, Apr 1803, *A. J. Bonpland* 3968 (Holotype, P; isotype, P!; fragment of holotype, P! US!; photograph of P isotype, OS! TEX!; photograph of probable B isotype, TEX!).

Melampodium angustifolium DC. Prodr. 5:519. 1836. TYPE: PERU [?]: "in Peruviae montanis, ad Oronocum," 1790-91, *T. Haenke* s.n. (Holotype, PR; isotypes, P [2]!; probable isotype, F!; photograph of G-DC isotype, F! NY! US! IDC! 800. 927: III.1![7]; photograph of P isotype, OS! TEX!). If the collection actually is from Peru, then the range of *M. americanum* would be extended much further south than its present southern limit in Guatemala. However, apparent mixing of label data of Haenke's specimens has been reported in at least three instances by other

[7]The method of citing specimens on Interdocumentation (IDC) microfiches described by Hepper (1968) is used here throughout the text. Taking the above citation as an example, the first number (800) refers to the specific herbarium in the IDC collection (here G-DC) followed by the numbers of: the individual microfiche (927), the particular line on the card (III), and the specific frame (=specimen) on the line (1).

workers (Hitchcock, 1909; Merrill, 1925; Tryon, 1955). Because Haenke also collected in Mexico in the region from Acapulco to Mexico City (Safford, 1905; Alston, 1934) where *M. americanum* is common, it seems likely that mixing of label data also has occurred here.

Melampodium kunthianum DC. Prodr. 5:519. 1836. *nom. nov.* Based on type of *M. sericeum* H.B.K.

Melampodium nelsonii Greenm. Proc. Amer. Acad. Arts & Sci. 41:260. 1905. TYPE: MEXICO: Michoacán, Volcano of Jorullo, 28 Mar 1903, *E. W. Nelson* 6939 (Lectotype chosen, GH!; isotypes, NY! US!; photograph of US isotype, TEX!).

Perennial subshrubs, 15-60 cm tall. Stems ascending, 1-2 mm diam, strigose to hispid-pilose with hairs 0.2-1 mm long. Peduncles 2.5-7.5 cm long. Leaves sessile, linear to ovate, 3-6 cm long, 0.2-2.7 cm wide, at apex acute-obtuse, at base attenuate to obtuse, with upper surface strigose with hairs 0.2-0.5 mm long, with lower surface sericeous; margin entire or lobed to pinnately divided into linear segments, at base usually pilose-hirsute with hairs up to 1 mm long. Heads 7-8 mm tall, 11-17 mm diam. Outer involucre cupulate, 7-10 mm diam; bracts 5, slightly connate at base, imbricate 2/3 their length (rarely separate), ovate to rhombic, 5-7 mm long, 3-4 mm wide, at apex acuminate, with abaxial surface strigose with hairs 0.5 mm long near apex, near base pilose to sericeous, at margin herbaceous. Fruits 2-3 mm long, with lateral surfaces smooth with ribs and few tubercles to verrucate-aculeate; hood apex mucronate (rarely muticous) to cirrhous, with tapering appendage up to 3 mm long. Ray florets 8-13; ligules yellow-orange, oblong-elliptic, 4-6 mm long, 1.5-3 mm wide. Disc florets 50-100; corollas yellow-orange, 2.1 mm diam, with throat and tube each 1 mm long. Paleae oblanceolate, 4 mm long, 1 mm wide; apex yellow, with margin entire to undulate becoming dentate-erose laterally; midrib prominent, pubescent with hairs 0.4 mm long. Chromosome number, $n = 10$.

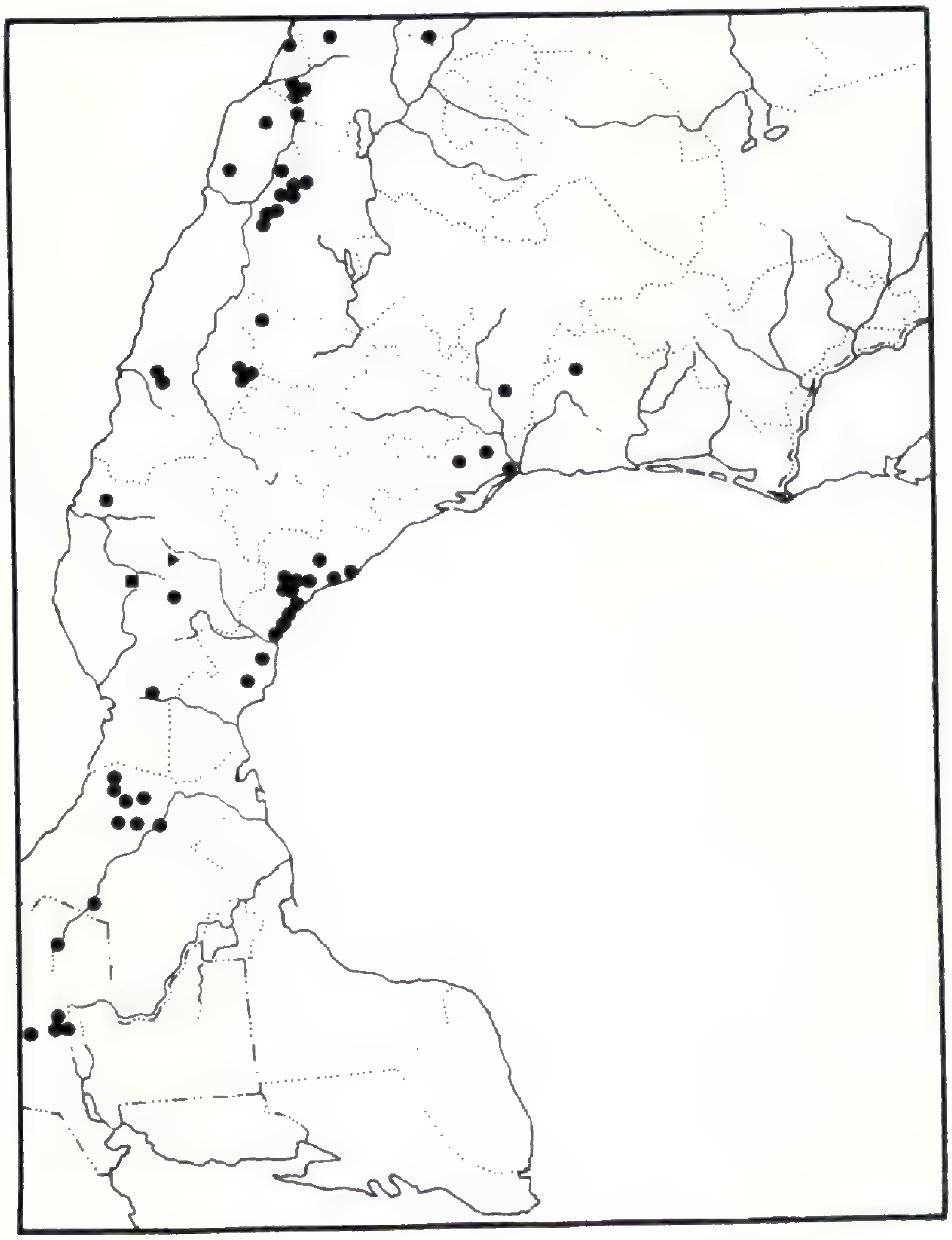


Fig. 11. Map of Mexico and adjacent Guatemala showing distribution of *Melampodium americanum* (dots), *M. glabribracteatum* (square), and *M. pringlei* (triangle). Three collections of *M. americanum* near Tepic, Nayarit, not shown.

Habitats ranging from savannas to pine-oak forests in Mexico on the eastern slope of the Sierra Madre Oriental and on the western slopes of the Sierra Madres Occidental and Sur, with extensions into Guatemala (Fig. 11), 210-2380 m. Flowering dates, Jan-Aug.

This species is very widespread, ranging from north in Tamaulipas, Mexico, to south into Guatemala and is found in diverse habitats from mountain pine forests to lowland savannas. As might be expected from such geographical

and ecological diversity, much morphological variability also is present. Although no formal varieties are proposed at this time, morpho-geographic trends do exist that need further study: (1) plants with short leaves with few and broad lobes and large heads found in the coastal lowlands near Alvarado, Veracruz; (2) plants with long leaves, pinnately divided into narrow lobes, found in the mountains of Chiapas and Guatemala; (3) short plants with small heads and a tendency toward the annual habit found in the mountains of the western Sierra Madre in Jalisco, Michoacán and Guerrero.

Three collections (*Feddema* 832; *King* 3699; *Rose, Standley and Russell* 14307) found in the northwestern range of this species (north of Tepic, Nayarit) also may deserve formal taxonomic status. The outer involucral bracts of these collections are more rhombic with narrower attenuate apexes as compared with the more typical ovate bracts of the rest of the species, and the ligules are longer and narrower than usual. A collection from Guerrero, however, *Hinton* 9134, approaches these Nayarit collections and seems to vitiate clear varietal or specific recognition. Obviously additional work, especially in the Tepic area, is needed.

REPRESENTATIVE SPECIMENS: **Guatemala.** BAJA VERAPAZ: ca 3 mi S of Salamá, 10 Jul 1960, *King* 3260 (DS, NY, TEX, UC, US); ca 14 mi W of Salamá, 14 Jul 1960, *King* 3358 (DS, NY, TEX, UC, US); ca 15 mi S of Rabinal, 14 Jul 1960, *King* 3364 (DS, NY, TEX, UC, US). EL PROGRESO: 35 mi NE of Guatemala, 30 Jul 1966, *Stuessy* 602 (TEX). HUEHUETENANGO: Uaxackanal, 1 Aug 1896, *Volkem* 2973 (F [photograph of US specimen], GH, NY, US). **Mexico.** CHIAPAS: ca 10 mi E of the Oaxaca-Chiapas border on rte 190, 23 Jun 1960, *King* 2980 (DS, NY, TEX, UC, US); ca 12 mi E of Cintalapa, 23 Jun 1960, *King* 2987 (DS, NY, TEX, UC, US); ca 33 mi S of Tuxtla Gutiérrez, 27 Jun 1960, *King* 3105 (DS, NY, TEX, UC, US); 30 mi SE of Comitán, 26 Jul 1966, *Stuessy* 571 (TEX); 1 mi N of Entronque Santa Isabel, 10 Aug 1966, *Stuessy* 632 (TEX). COLIMA: Colima, 24 Oct 1910, *Orcutt* 4516 (DS, F, GH); Colima, 9 Jan-6 Feb 1891, *Palmer* 1172 (G, GH, NY, UC, US); 5 mi NW of rte 110 on rd to Alzada, 25 Aug 1966, *Stuessy* 724 (TEX); Alzada, 25 Aug 1966, *Stuessy* 727 (TEX); Manzanillo, 1863-64, *Xantus* s.n. (F, GH [2], NY [2], US [2]). GUERRERO:

Placeres, Puerta, 22 Jul 1936, *Hinton* 9134 (ARIZ, TEX, US); ca 9 mi NW of Taxco, 14 Mar 1961, *King* 4168 (F, NY, TEX, UC, US); ca 25 mi NE of Acapulco, 14 Mar 1961, *King* 4178 (F, NY, TEX, UC, US). JALISCO: Río Cuvianes, 13 Jun 1892, *Jones* 274 (POM [2], US); Río Cuvianes, 13 Jun 1892, *Jones* 369 (POM, US); ½ km S of Puente San Pedro on rd from Colima to Ciudad Guzmán, 31 Jul 1960, *Koeppen & Iltis* 618 (TEX, UC); 10 mi S of Autlán toward La Resolana, 28 Jun 1949, *R. & C. Wilbur* 1395 (US). MÉXICO: 8 km SW of Luvianos, 2 Sep 1965, *Rzedowski* 20748 (OS). MICHOACÁN: Coalcomán, 5 Jan 1939, *Hinton et al.* 12871 (NY, US); Uruapán, Tancitaro, 26 Oct 1940, *Hinton et al.* 15587 (ARIZ, GH, TEX, US); ca 32 km N of Playa Azul (near Los Encinos), 25-31 Oct 1961, *King & Soderstrom* 4992 (NY, SMU, TEX, UC, US); Apatzingán, canyon below Acahuato, 15 Aug 1941, *Leavenworth & Hoogstraal* 1589 (F, GH); 7 mi S of Ario de Rosales, 20 Aug 1966, *Stuessy* 688 (TEX). NAYARIT: Mirador del Águila, ca 14 mi N of Tepic, 21 Aug 1959, *Feddema* 832 (MICH [2]); ca 25 mi N of Tepic, 12 Aug 1960, *King* 3699 (DS, NY, TEX, UC, US); vicinity of Acaponeta, Tepic, 10 Apr 1910, *Rose, Standley & Russell* 14307 (US); Ixtlán del Río — San Marcos, 5 Aug 1921, *Thompson* s.n. (NY). OAXACA: Estación San Marcos, Istmo de Tehuantepec, 21 Jan 1907, *Conzatti* 1706 (F, GH, US); vicinity of Yalalag [Hidalgo Yalalag], Jul 1894, *Nelson* 947 (US); rd between Llano Grande & Pinotepa, 19 Feb 1895, *Nelson* 2339 (US); between Guichocovi & Lagunas, 27 Jun 1895, *Nelson* 2740 (GH, US). SAN LUIS POTOSÍ: San Dieguito, 13-16 Jun 1904, *Palmer* 459 (US). TAMAULIPAS: 10 km NW of El Progreso, 22 Aug 1941, *Stanford, Retherford & Northcraft* 1077 (ARIZ, DS, GH, NY, UC). VERACRUZ: La Purga, 27 Jan 1906, *Greenman* 279 (F, GH, NY); ca 26 mi E of Cuitláhuac, 6 Jun 1960, *King* 2682 (DS, NY, TEX, UC, US); ca 14 mi SE of Alvarado, 7 Jun 1960, *King* 2718 (DS, NY, TEX, UC, US); vicinity of Pueblo Viejo, 2 km S of Tampico, 1-2 Jun 1910, *Palmer* 535 (GH, NY, US); 63 mi S of jct rtes 110 & 105, 6 Jul 1966, *Stuessy* 471 (TEX).

2. **Melampodium diffusum** Cass. Dict. Sci. Nat. 59:238. 1829. TYPE: PHILIPPINE ISLANDS: Manila, summer 1825, *F. L. Busseuil* s.n. (Holotype, P?).

Melampodium manillense Less. Linnaea 6:155. *t. 2, f. G* (fruit). 1831. TYPE: PHILIPPINE ISLANDS: "in Luçonia" [Luzon], 1831, *A. Chamisso* s.n. (Holotype, B?; photograph of G-DC isotype (?), IDC 800. 927:I. 6!).

Melampodium lanceolatum DC. Prodr. 5:519. 1836. TYPE: PHILIPPINE ISLANDS or MEXICO: locality and date unknown, *L. Née* s.n. (Holotype, G-DC; isotype, MA!; photo-

graph of holotype, US!, IDC 800. 927:II. 6!; photograph of MA isotype, OS! TEX!).

Melampodium diffusum Cass. var. *lancelatum* (DC.) Robins. Proc. Amer. Acad. Arts & Sci. **36**:460. 1901.

Annual herbs, 25-40 cm tall. Stems erect, 1-5 mm diam, subglabrous at base to strigillose-hispidulous above with hairs up to 0.8 mm long. Peduncles 0.8-6.5 cm long. Leaves usually sessile (sometimes with petioles up to 3 mm long), lanceolate to narrowly ovate, 2.5-5.5 cm long, 0.5-1.5 (–3) cm wide, at apex acute, at base attenuate to somewhat obtuse, with upper surface strigose with hairs 0.3 mm long, with lower surface sericeous; margin entire to 1-3 cleft, hispid with hairs up to 1.5 mm long. Heads 5-7 mm tall, 6-11 mm diam. Outer involucre cupulate, 5-9 mm diam; bracts 5, slightly connate at base, imbricate 1/2 their length, ovate, 2.5-6 mm long, 1.5-4 mm wide, at apex acuminate, with abaxial surface strigillose with hairs 0.3 mm long, at margin herbaceous. Fruits 1.8-2.3 mm long, with lateral surfaces smooth and longitudinally ribbed to tuberculate-aculeate; hood apex mucronate to cirrhous (rarely muticous)[8], with appendage up to 2 mm long. Ray florets 8-13; ligules yellow-orange, oblong-elliptic, 2.5-4 mm long, 1-3 mm wide. Disc florets 40-60; corollas yellow-orange, 1.3 mm diam, with throat 0.6 and tube 0.4 mm long. Paleae oblanceolate, 3 mm long, 0.9 mm wide; apex yellow, with margin entire to moderately erose; midrib prominent, mostly glabrous. Chromosome number, $n = 10$.

Tropical deciduous forests in Colima and near Acapulco, Guerrero, Mexico, and Manila in the Philippine Islands (Fig. 12), 30-300 m. Flowering dates, Jun-Jan.

One collection, *Winbery & Rowell* 2492, approaches the perennial habit in this characteristically annual species. Because this collection also possesses heads and leaves larger than usual, the suggestion of hybridization with nearby *M. americanum*, especially at higher altitudes in Guerrero, cannot be excluded.

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[8]One collection, *Palmer* 3 (F), has fruits with hoods and no hoods in one head of the single plant.

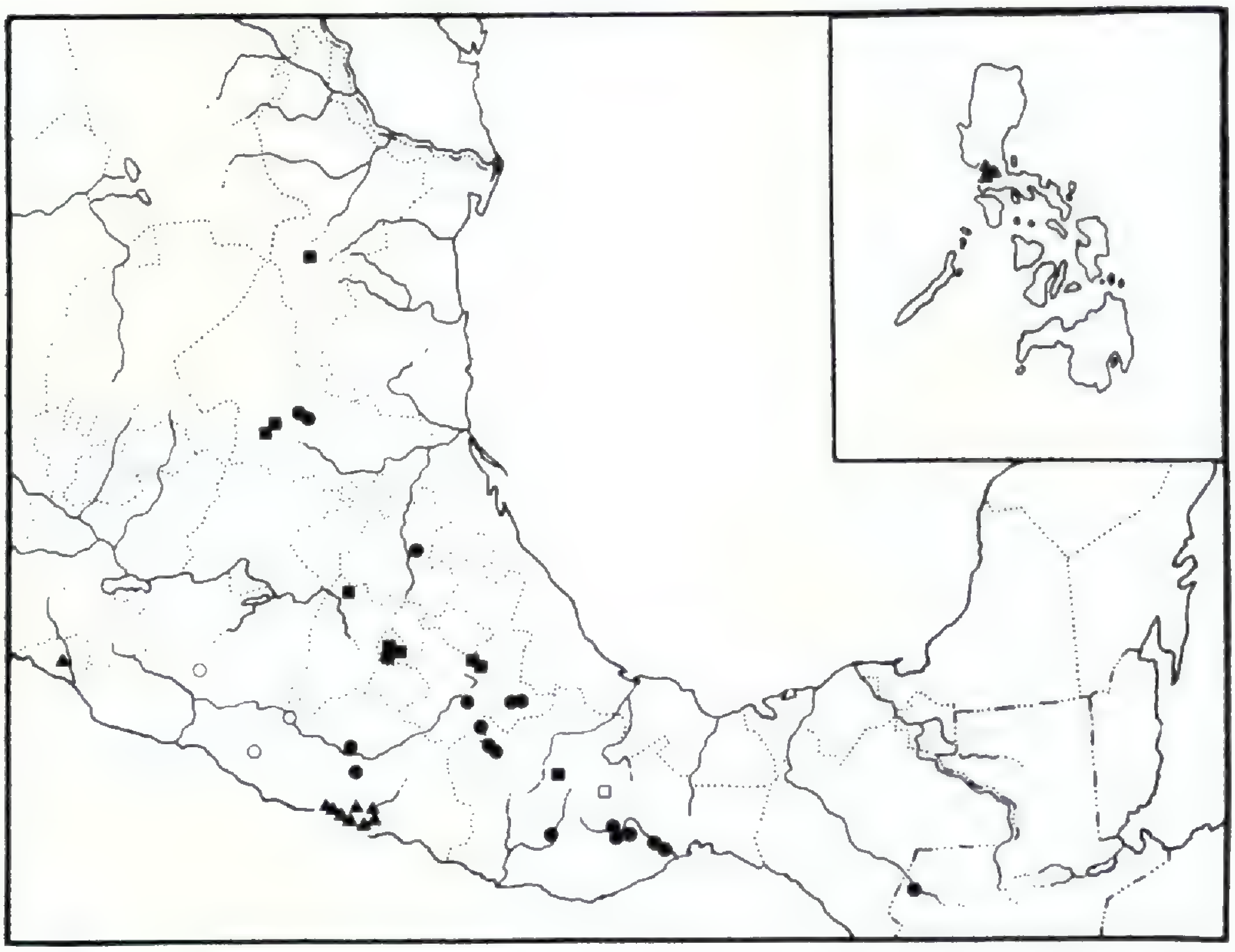

Fig. 12. Map of Mexico, adjacent Guatemala, and the Philippine Islands (inset), showing distribution of *Melampodium diffusum* (triangles), *M. longifolium* (closed squares), *M. longipilum* (dots), *M. mimulifolium* (open square), and *M. pilosum* (circles).

Robinson (1901, p. 456) previously noticed the unusual bicentric distribution of this species and offered the following plausible explanation:

> "As the genus is otherwise American, the occurrence of this species in a region so remote has always been problematic, and it has been a matter of no small interest to find the Philippine plant closely matched by specimens recently collected by Dr. Edward Palmer, about Acapulco, Mexico. There can therefore be scarcely a doubt that the genus is in reality of New World origin, and that a single Mexican species was accidentally introduced into the Philippines, where it attracted scientific attention before it was recognized in America. This seems the more likely from the circumstance that Mexico and the Philippines were under the same national control, and early con-

nected by a certain amount of oceanic traffic [demonstrated by Merrill (1954)]. This being the case, the transference of seed from Acapulco, the most important Pacific port of Mexico, to the neighborhood of Manila, presents no inherent improbability."

REPRESENTATIVE SPECIMENS. **Mexico.** COLIMA: 5-10 mi N of Tecomán, 25 Dec 1958, *Thompson & Fields* 332(TEX). GUERRERO: above Playa Hornos ca 1 mi E of Acapulco, 9 Jan 1944, *Barkley* 14142 (F, GH, POM, TEX, UC, US); near Pie de la Cuesta NW of Acapulco, 5 Jan 1944, *Barkley* 14163 (TEX, US); 20 mi NE of Acapulco, 20 Aug 1947, *Barkley, Webster & Paxson* 17M724 (TEX); between Acapulco & Pueblo Nuevo, 13 Nov 1882, *Hancock* 25 (F, K); 8 mi E of Acapulco, 22 Jun 1952, *Mockford & Rowell* 2769 (SMU); near Acapulco, 25-31 Oct 1895, *Palmer* 3 (F, GH, NY, UC, US); near Acapulco, Dec 1895, *Palmer* 281 (GH, US); 26 mi W of Acapulco, 19 Aug 1961, *Powell & Edmondson* 758 (F, TEX); 5 mi SW of Tierra Colorada, 17 Jun 1952, *Winbery & Rowell* 2492 (SMU); 1 mi N of Acapulco, 27 Aug 1965, *Stuessy* 366 (TEX); near S shore of Acapulco bay, 28 Aug 1965, *Stuessy* 369 (TEX). **Philippine Islands.** LUZON: Cavite, Aug 1905, *Foxworthy* 167 (NY, US); Cavite, Binacayan, 21 Jan 1917, *Merrill* 10641 (NY, US); Cavite, Bacoor, Jul 1910, *Robinson* 11835 (F); Laguna, 17 Apr 1953, *Canicosa* 1103 (US); Nueva Vizcaya, Bambang, Jan 1924, *Clemens* s.n. (UC); Nueva Vizcaya, Benquet, Dec 1908, *Curran & Merritt* 15837 (US); Nueva Vizcaya, Jan 1913, *McGregor* 20181 (US).

3. **Melampodium pilosum** Stuessy, Brittonia 22:115. *f. 6.* 1970. TYPE: MEXICO: Guerrero, Montes de Oca, Vallecitos, 28 Sep 1937, *G. B. Hinton* 11428 (Holotype, NY!; isotypes, G! GH! UC! US!).

Annual herbs, 8-28 cm tall. Stems erect to decumbent, 1-2 mm diam, pilose with hairs up to 1.5 mm long. Peduncles 3-3.7 cm long. Leaves with petioles 2 mm long, lanceolate to narrowly ovate, 3-6 cm long, 1-1.3 cm wide, at apex acute, at base obtuse, with upper surface near apex strigose with hairs 0.3 mm long, near base pilose with hairs 1.5 mm long, with undersurface markedly sericeous; margin entire to rarely 1-2 lobed, irregularly ciliate with hairs 0.3 mm long, toward base pilose with hairs up to 2 mm long. Heads 6-7 mm tall, 7.5-11 mm diam. Outer involucre cupulate, 6.5-9 mm diam; bracts 5, slightly connate at base, im-

bricate 1/2 their length, ovate to narrowly ovate, 4-5 mm long, 2-2.5 mm wide, at apex acuminate, with abaxial surface pilose with hairs 1 mm long, at margin herbaceous. Fruits 1.6-2.5 mm long, with lateral surfaces 3-ribbed and smooth to very weakly tuberculate; hood apex mucronate to cirrhous[9], with tapering appendage up to 2 mm long. Ray florets 7-8; ligules yellow-orange, ovate-oblong, 3-4.5 mm long, 2-3 mm wide. Disc florets 55-80; corollas yellow, 1.2 mm diam, with throat and tube each 0.7 mm long. Paleae oblanceolate, 4 mm long, 1 mm wide; apex yellow, with margin erose becoming laciniate laterally; midrib prominent, hirsutulous with hairs 0.3 mm long. Chromosome number, $n = 10$.

Tropical deciduous forests in Michoacán and Guerrero, Mexico (Fig. 12), 910-1220 m. Flowering dates, Aug-Sep.

REPRESENTATIVE SPECIMENS. **Mexico.** GUERRERO: Coyuca, Chacamerito, 14 Aug 1934, *Hinton* 6436 (F, G, GH, NY [2], US). MICHOACÁN: ca 1 mi N of Huacana, 11 Aug 1965, *Melchert & Sorensen* 6085 (ENCB); 25 mi S of Ario de Rosales, 20 Aug 1966, *Stuessy* 695 (TEX).

4. **Melampodium longipes** (A. Gray) Robins. Proc. Amer. Acad. Arts & Sci. 36:459. 1901.

Melampodium sericeum Lag. var. *longipes* A. Gray. Proc. Amer. Acad. Arts & Sci. 22:423. 1887. TYPE: MEXICO: Jalisco, Tequila, "base of mountains," Aug 1886, *E. Palmer* 391 (Holotype, GH!; isotypes, G! K! MO! NY [2]! US!; photograph of US isotype, TEX!).

Annual herbs, 10-46 cm tall. Stems erect, 1-2 mm diam, hispid-pilose with hairs up to 1 mm long. Peduncles 5-8 cm long. Leaves sessile, linear and entire to markedly pinnately parted, 3-7 cm long, 0.3-3.5 cm wide, at apex acute-obtuse, at base mostly attenuate (less often obtuse), with upper surface strigose with hairs 0.3-1 mm long, with lower surface sericeous; margin entire, at base hispid-pilose with hairs up to 2 mm long. Heads 6.5-8.5 mm tall, 10-12 mm

[9]The holotype has fruits possessing hoods with both mucronate and cirrhous apexes.

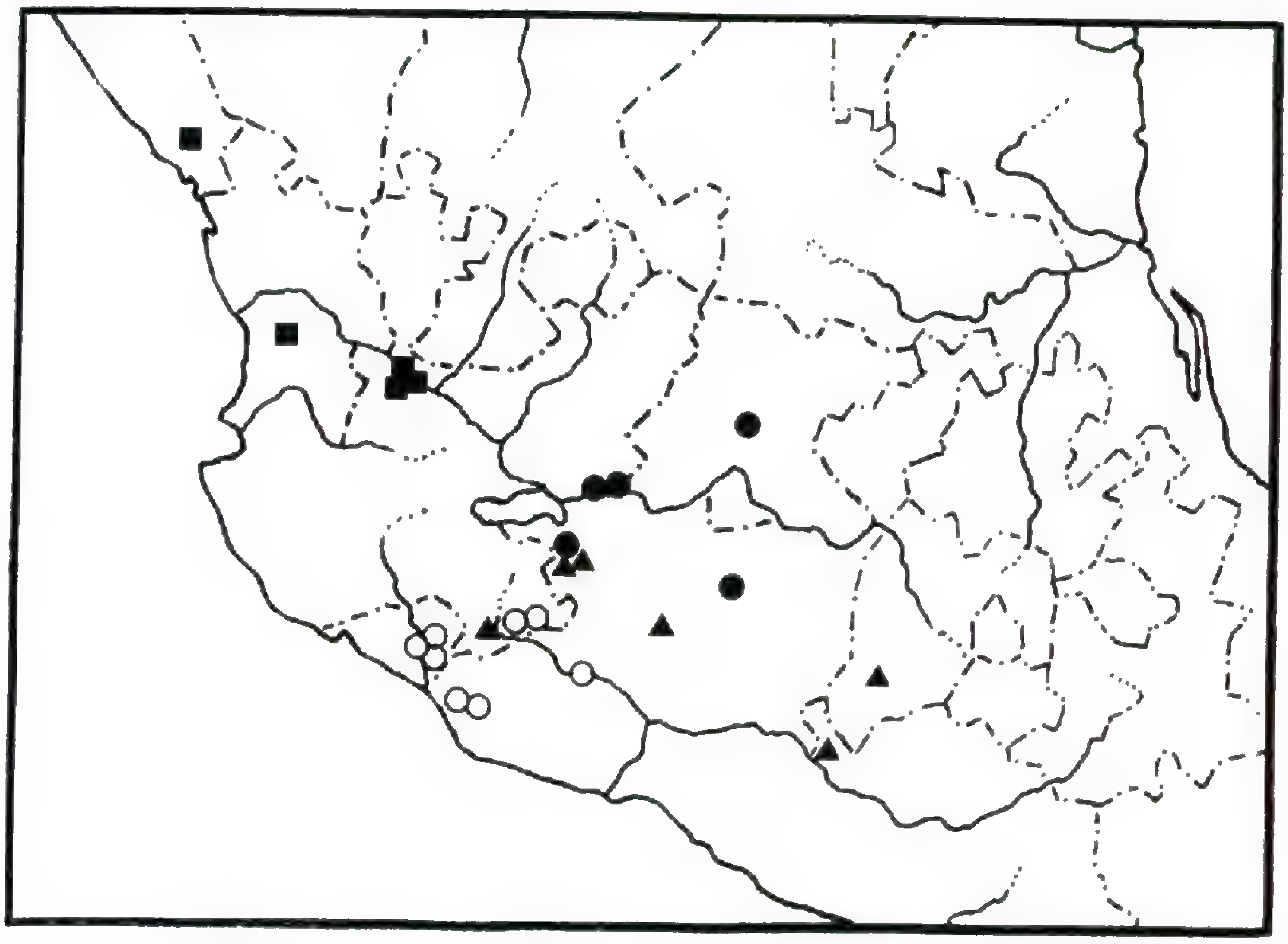

Fig. 13. Map of central Mexico showing distribution of *Melampodium dicoelocarpum* (triangles), *M. glabrum* (dots), *M. longipes* (squares), and *M. nutans* (circles). One collection of *M. nutans* from Oaxaca not shown.

diam. Outer involucre cupulate, 7-8 mm diam; bracts 5, slightly connate at base, imbricate 2/3 their length, obovate, 4-5 mm long, 2.5-3 mm wide, at apex acuminate, with abaxial surface pilose with hairs 1 mm long (more dense near base); margin herbaceous. Fruits 2-3 mm long, with lateral surfaces tuberculate with 3-4 longitudinal ribs; hood apex mucronate to cirrhous, with tapering appendage up to 3 mm long. Ray florets 8-10; ligules yellow-orange, ovate-oblong, 3-5 mm long, 1-3 mm wide. Disc florets 50-80; corollas yellow-orange, 2 mm diam, with throat 0.8 mm and tube 0.7 mm long. Paleae oblanceolate, 3.5 mm long, 0.8 mm wide; apex yellow, with margin entire to undulate; midrib distinct, mostly glabrous. Chromosome number, $n = 10$.

Dry hillsides in Jalisco, Nayarit and Sinaloa, Mexico (Fig. 13), ca 1220 m. Flowering dates, Aug-Sep.

This species is very similar to both *M. americanum* and *M. linearilobum*. *M. longipes* usually can be distinguished from either of these two taxa by its annual habit (perennial in *M. americanum*) and herbaceous outer involucral bracts (conspicuously scarious in *M. linearilobum*). The leaves divided markedly into pinnatifid segments and the yellowish hue of the stems also serve as additional features to help recognize *M. longipes* from among its close relatives.

One collection, *Rose* 3183, from Sinaloa tends more toward a perennial habit, and the leaves are more distinctly pinnatifid. Nevertheless, these specimens appear to fall within the limits of *M. longipes.*

REPRESENTATIVE SPECIMENS. **Mexico.** JALISCO: ca 2 mi NW of Tequila, 8 Aug 1960, *King* 3662 (DS, MICH, NY, TEX, UC, US); Tequila, 22 Sep 1893, *Pringle* 4598 (F, G [2], GH, MICH, MSC, NY, P, UC, US); 2 mi NW of Tequila, 3 Sep 1965, *Stuessy* 397 (TEX), 26 Aug 1966, *Stuessy* 738 (TEX). NAYARIT: El Maguey, Sierra Madre, Tepic, 26 Aug 1905, *Goldsmith* 132 (DS, F, GH, NY, UC, US). SINALOA: between Rosario & Colomas, 13 Jul 1897, *Rose* 3183 (GH, US).

5. **Melampodium linearilobum** DC. Prodr. 5:518. 1836. TYPE: MEXICO: "ad Guilotepec et Las Bacas," Sep 1831, *L. Alamán* s.n. (Holotype, G-DC; isotype, G!; photograph of holotype, IDC 800. 927: II. 2!; photograph of G isotype, F! OS! TEX! US!).

Melampolium canescens Brandg. Zoe 5:222. 1905. TYPE: MEXICO: Sinaloa, Cofradia [ca 30 mi E of Culiacán near Durango border], 22 Oct 1904, *T. S. Brandegee* s.n. (Lectotype chosen, UC!; isotypes, GH! POM! US!).

Annual herbs, 6-50 cm tall. Stems erect, 1-3 mm diam, strigillose-strigose with hairs 0.8 mm long. Peduncles 3.5-5.5 cm long. Leaves sessile, linear and entire to markedly pinnately parted, 3-5.5 cm long, 0.3-3 cm wide, at apex acute-obtuse, at base attenuate to obtuse, with upper surface strigose with hairs 0.2-1 mm long, with lower surface sericeous; margin entire, at base hispid-pilose with hairs up to 2 mm long. Heads 5-7 mm tall, 7-11 mm diam. Outer

involucre cupulate, 6-10 mm diam; bracts 5, slightly connate at base, imbricate 1/2 their length, narrowly ovate to somewhat obovate, 3.5-5.5 mm long, 2.5-3 mm wide, at apex acute, with abaxial surface pilose-strigose with hairs 1-1.8 mm long; margin conspicuously scarious. Fruits 2-3 mm long, with lateral surfaces smooth and striate to tuberculate; hood apex muticous to cirrhous, with appendage up to 2.5 mm long. Ray florets 7-8; ligules yellow-orange, ovate-orbicular (often with imbricate margins), 2-4 mm long, 2-5 mm wide. Disc florets 45-75; corollas yellow-orange, 2.4 mm diam, with throat 0.9 mm and tube 0.5 mm long. Paleae oblanceolate, 4 mm long, 1 mm wide; apex yellow, with margin entire (rarely erose); midrib prominent, mostly glabrous. Chromosome number, $n = 10$.

Tropical deciduous and pine forests of the western Sierra Madres of Mexico and into Central America to Costa Rica (Fig. 14), 20-1620 m. Flowering dates, Jul-Oct.

The conspicuous scarious margins (colored orange-yellow when fresh) of the outer involucral bracts of *M. linearilobum*. The type of *M. canescens* from Sinaloa has linear, members of series *Melampodium*. Were it not for this characteristic bract feature, *M. linearilobum* would be very difficult to distinguish from *M. longipes*.

In spite of considerable vegetative variability, no intraspecific categories have been recognized within *M. linearilobum*. The type of *M. canescens* from Sinaloa has linear, entire leaves, as do other collections from nearby areas, but plants with similar leaves also appear in Central America and in scattered localities in Mexico. As a further indication of the plasticity of leaf shape, in many plants the upper leaves are linear and entire, while those lower on the stem are once or twice pinnatifid. Due to this vegetative plasticity, *M. canescens* is considered herein to be synonymous with *M. linearilobum*.

REPRESENTATIVE SPECIMENS. **Costa Rica.** GUANACASTE: Bolson River, 16 Jul 1918, *W. & H. Rowlee* 179 (NY, US). **El Salvador.** AHUACHAPÁN: 1921, *Padilla* 1 (US), 1921, *Padilla* 242 (US), 1923,

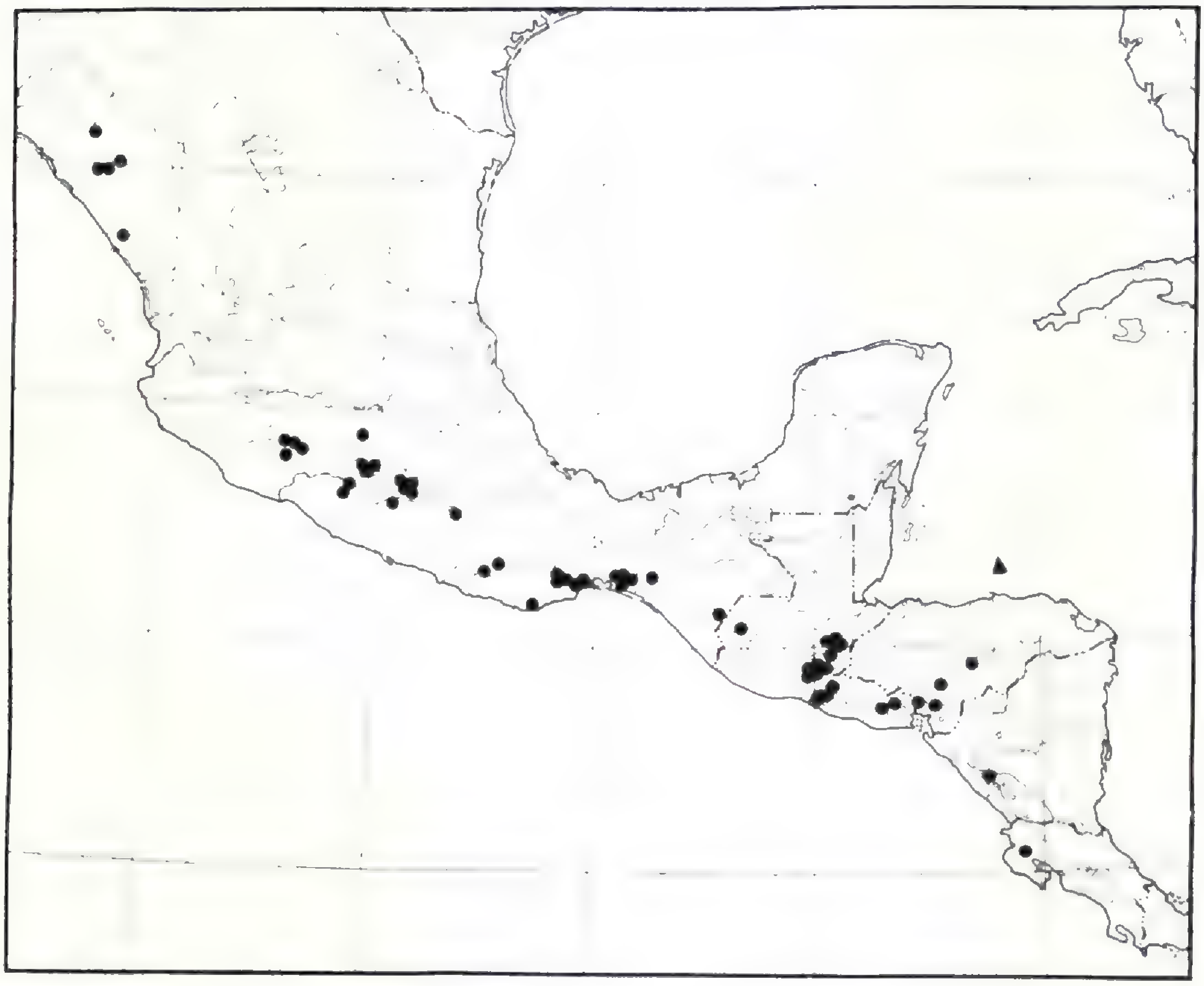

Fig. 14. Map of Mexico and Central America showing distribution of *Melampodium linearilobum.*

Padilla 586 (US). MORAZÁN: ca 8 km SW of Montecristo, 3 Dec 1941, *Tucker* 455 (F, GH, NY, SMU, UC, US). SANTA ANA: near Chalchuapa, 1922, *Calderón* 979 (GH, NY, US). USULUTÁN: 24 mi E of turnoff to San Vicente on rte 1, 3 Aug 1966, *Stuessy* 613 (TEX). **Guatemala.** CHIQUIMULA: near Ipala, 23 Oct 1939, *Steyermark* 30309 (F). HUEHUETENANGO: between San Ildefonso Ixtahuacán & Cuilco, 16 Aug 1942, *Steyermark* 50724 (F, NY). JUTIAPA: between Suchitán & Sta Catarina, Jul 1870, *Bernoulli* 709 (NY); near Jutiapa, 20 Dec 1938, *Standley* 60493 (F); between Jutiapa & Plan de Urrutia, 28 Oct 1940, *Standley* 75620 (F, US); 8 mi NE of Jutiapa, 2 Aug 1966, *Stuessy* 607 (TEX). QUICHÉ: 1942, *Ignacio* 1495 (F). ZACAPA: near divide on rd between Zacapa & Chiquimula, 9 Oct 1940, *Standley* 73774 (F); between Río Hondo & Santa Cruz, 11 Oct 1940, *Standley* 74071 (F); between Río Hondo & Santa Cruz, 11 Oct 1940, *Standley* 74125 (F, US); near La Fragua, 14 Oct 1940, *Standley* 74813 (F); near Sta Rosalia, 4 Oct 1939, *Steyermark* 29041 (F). **Honduras.** CHOLUTECA: vicinity of Pespire, 18-27 Oct 1950, *Standley* 27175 (F). FRANCISCO MORAZÁN: El Chile, Tegucigalpa, 18 Sep 1950,

Standley 26708 (F). OLANCHO: near Río Telica, 20 Nov 1963, *Molina* 13346 (F). VALLE: 21 Jan 1956, *Molina* 5899 (F). **Mexico.** CHIAPAS: Chicomucelo, 14 Jul 1941, *Matuda* 4444 (4504) (F); valley of Jiquipilas, 16-18 Aug 1895, *Nelson* 2949 (GH, US). DURANGO?: Lodiego [25°N, 106°45'W; McVaugh, 1956], 9-15 Oct 1891, *Palmer* 1609 in part (US [2]). GUERRERO: Coyuca de Catalán, Pungarabato, 10 Jul 1934, *Hinton et al.* 6270 (F, GH, NY, US); Mina, Placeres, 18 Aug 1936, *Hinton et al.* 9113 (ARIZ, GH, TEX, US); near Iguala, 26 Apr 1900, *Pringle* 9162 (F, GH, NY, US); Los Amates Station, 28 Sep 1905, *Pringle* 10065 (ARIZ, F, G, NY, SMU, UC, US); ca 50 mi S of Cuernavaca, 26 Aug 1965, *Stuessy* 361 (TEX). MÉXICO: Temascaltepec, Limones, 7 Nov 1932, *Hinton* 2513 (GH, NY [2]); Temascaltepec, Palmar, 9 Aug 1934, *Hinton et al.* 6420 (NY, US); San Antonio, Tlatlaya, 20 Jul 1954, *Matuda et al.* 31141 (US); Palmar Chico, Amatepec, 24-25 Aug 1954, *Matuda et al.* 31314 (US). MICHOACÁN: Zitacuaro, Zitacuaro-Tiamaro, 9 Sep 1938, *Hinton et al.* 13214 (ARIZ, GH, TEX, US); Tancitaro, above Apatzingán, 13 Aug 1941, *Leavenworth & Hoogstraal* 1480 (F, GH, NY); Apatzingán, below Acahuato, 15 Aug 1941, *Leavenworth & Hoogstraal* 1588 (F); 1 mi N of Apatzingán, 21 Aug 1966, *Stuessy* 697 (TEX); 4 mi N of Nueva Italia, 21 Aug 1966, *Stuessy* 698 (OS, TEX). OAXACA: Salina Cruz, 23 Aug 1935, *Fisher* 35321 (ARIZ, F, NY, SMU, US); ca 37 mi W of Tehuantepec, 23 Jul 1960, *King* 3454 (DS, NY, TEX, UC, US); ca 3 mi NE of Huajuapán de León, 28 Jul 1960, *King* 3539 (TEX); Playa de Puerto Ángel, Oct 1917, *Reko* 3812 (US); 24 mi S of Sola de Vega, 13 Aug 1966, *Stuessy* 650 (TEX). SINALOA: Cerro Colorado, near Cofradia, 2 Nov 1904, *Brandegee* s.n. (GH, UC); Cofradia, 25 Nov 1939, *Gentry* 5039 (ARIZ, GH, NY); Las Mesas, Sierra Surotato, 25 Aug 1941, *Gentry* 6153 (ARIZ, GH, NY); La Noria, 10 Oct 1925, *Mexia* 240 (UC), 14 Oct 1925, *Mexia* 349 (POM, UC, US). **Nicaragua.** GRANADA: 1 mi S of Granada, 6 Aug 1966, *Stuessy* 619 (TEX).

2. Series **Leucantha** Stuessy, ser. nov.

Plantae perennes suffruticosae; folia anguste ovata vel lineata, saepe lobata, subtus strigosa; ligulae eburneae, plus quam vel raro circa 2 mm longae; involucrum extimum marginibus herbaceis; fructi cucullati. Species 6-8. Typus: *Melampodium leucanthum* Torr. & A. Gray.

6. **Melampodium leucanthum** Torr. & A. Gray, Fl. N. Amer. 2(2):271. 1842. TYPE: TEXAS: without locality or date, *J. L. Riddell* s.n. (Holotype, NY?). Type not located, but the following collection cited by Gray (1852) clearly is repre-

sentative: "Hills near El Paso," Apr 1849, *C. Wright* 311 (GH! UC! US!).

Perennial subshrubs, 15-60 cm tall. Stems ascending, 1.1-2.5 mm diam, strigillose (rarely hispid) with hairs 0.1-0.2 mm long. Peduncles 3-7 cm long. Leaves sessile, linear-oblong, 2.1-4.5 cm long, 0.13-1 cm wide, at apex and base obtuse, with both surfaces strigillose with hairs 1-2 mm long; margin entire to pinnately 6-lobed, at base strigillose with hairs 0.1-0.2 mm long. Heads 6-8 mm tall, 20-37 mm diam. Outer involucre cupulate, 10-13 mm diam; bracts 5, connate 1/2 to 3/4 their length, ovate, 5-7 mm long, 4-5.1 mm wide, at apex acute, with abaxial surface strigillose-strigose with hairs 0.1-0.7 mm long; margin herbaceous. Fruits 1.5-2.6 mm long, with lateral surfaces aculeate-verrucate; hood apex muticous (very rarely mucronate). Ray florets 8-13; ligules cream-white, oblong-elliptic, 7-13 mm long, 2.5-8 mm wide. Disc florets 25-50; corollas yellow, 1 mm diam, with throat 1.2 mm and tube 0.8 mm long. Paleae oblong-elliptic, 2.9 mm long, 1.1 mm wide; apex yellow, with margin laciniate; midrib prominent, often strigillose with hairs 0.1 mm long. Chromosome numbers, $n = 10$ and 20.

Calcareous soils throughout western and central Texas (stopping at the Edward's Plateau), Arizona, New Mexico, and portions of Oklahoma, Kansas, Colorado, and northern Mexico (Fig. 15), 490-2590 m. Flowering dates, Apr-Sep.

This species is the familiar "blackfoot daisy" of the southwestern United States that has been gathered extensively by many different collectors. Despite its abundance, however, the relationships to *M. cinereum* and *M. argophyllum* have been unclear for many years. Recent studies have shown (Stuessy, 1971c; present treatment) that *M. leucanthum* has a separate distribution that comes only within ten miles of *M. cinereum* at the edge of the Edward's Plateau.

Both $2n$ and $4n$ cytological races have been reported for this species (Turner and King, 1962; Stuessy, 1971b & c),

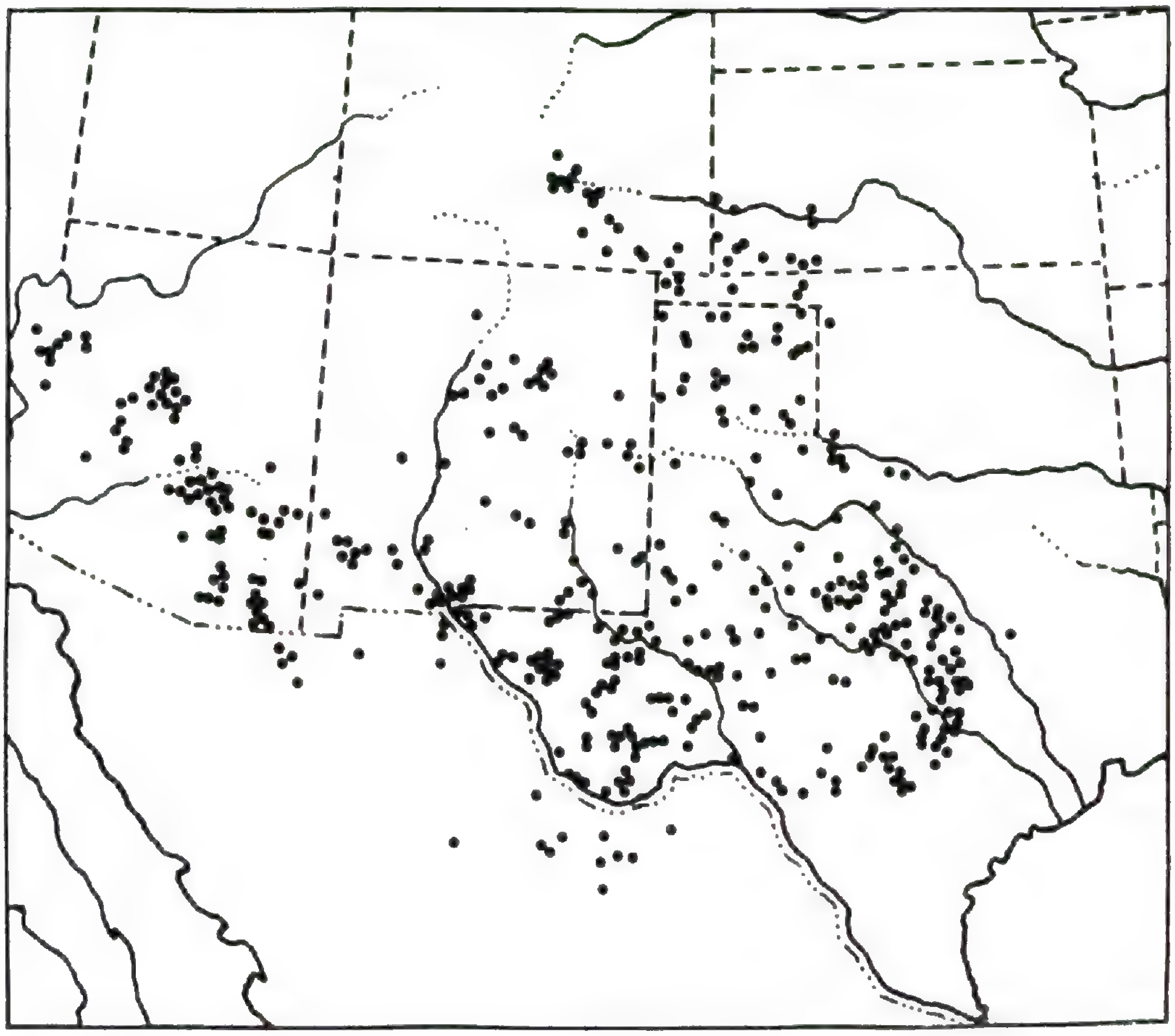

Fig. 15. Map of the southwestern United States and adjacent Mexico showing distribution of *Melampodium leucanthum.*

and they are morphologically indistinguishable. Evidence for treating these cytotypes as informal races having been derived by spontaneous autopolyploidy has been reviewed by Stuessy (1971c).

REPRESENTATIVE SPECIMENS. **Mexico.** CHIHUAHUA: 7 mi N of Mesteñas, 25 Sep 1938, *Johnston* 7959 (GH, US); Organos Mts, 8 Sep 1937, *LeSueur* 1456 (F, TEX); Colonia Díaz, 20-21 Sep 1899, *Nelson* 6447 (GH, US); hills near Chihuahua, 5 Oct 1886, *Pringle* 1019 (F, NY, US); 20 mi S of Ciudad Júarez, 21 Jul 1937, *Shreve* 7918 (ARIZ, GH, US); 59 mi N of Villa Ahumada, 23 Aug 1967, *Stuessy* 1122 (TEX). COAHUILA: Del Carmen Mts, 6 Sep 1936, *Marsh* 855 (F, GH, TEX); Cañon del Indio Felipe, close to the Chihuahuan boundary, 27-29 Sep 1940, *Stewart* 84 (GH). SONORA: Colonia Morelos, 15 Sep-4 Oct 1941, *White* 4587 (ARIZ, GH); 5 mi E of Esqueda on rd to Río de la Tierra, 10 May 1948, *Wiggins* 11765

(DS, US). UNITED STATES. **Arizona:** COCHISE CO., near Douglas, 16 Aug 1907, *Goodding* 2399a (DS, GH, US). GILA CO., ca 3 mi N of Dripping Springs turnoff, 11 Apr 1965, *Niles* 572 (ARIZ, TEX); GREENLEE CO., 7 mi N of Metcalf, 6 Jun 1935, *Maguire, Richards & Moeller* 11849 (ARIZ, GH, NY); MARICOPA CO., 3 mi N of Sunflower, 9 Apr 1960, *Russell* 11511 (SMU [2], UC); MOHAVE CO., Kingman, 18 Apr 1935, *Kearney & Peebles* 11133 (ARIZ, GH, US); PIMA CO., 3 mi N of Greaterville, 17 Aug 1967, *Turner* 5735 (TEX); YAVAPAI CO., 10 mi SW of Congress, 21 Apr 1962, *Turner* 4790 (DS, FSU, SMU, TEX); YUMA CO., Squaw Canyon, Harquahala Mts, 9 Sep 1952, *Wright* 42-54 (ARIZ). **Colorado:** BACA CO., 25 mi S of Pritchett, 11 Jul 1947, *Porter* 4262 (GH, RSA, SMU, TEX); EL PASO CO., below Colorado Springs, 29 May 1878, *Jones* 117 (F, POM [2]); FREMONT CO., Canon City, 2 Jul 1920, *Clokey* 3946 (DS, F, GH, NY, POM, UC, US); PROWERS CO., 31 mi S of Lamar, 6 Jun 1967, *Irving* 825 (TEX); PUEBLO CO., 12 mi S of Pueblo, 7 Jun 1922, *Wiegand & Upton* 4439 (NY). **Kansas:** FORD CO., 3 mi S of Dodge City, 9 Jul 1950, *Horr* 3444 (GH, US); HAMILTON CO., vicinity of Syracuse, 15 Sep 1912, *Rose & Fitch* 17043 (NY, US); MEADE CO., 16 mi SE of Meade, 16 Aug 1939, *Horr & Franklin* E278 (F, GH, SMU, TEX, UC, US); SEWARD CO., Jul 1891, *Carleton* 331 (ARIZ, F, US). **New Mexico:** BERNALILLO CO., ca 2 mi E of Albuquerque, 1915, *Kammerer* 48 (DS, TEX); CHAVES CO., 20 mi S of Roswell, Aug 1900, *F. & E. Earle* 295 (NY, POM, US); DE BACA CO., 6 mi E of Yeso, 8 Aug 1967, *Turner* 5673 (TEX); DONA ANA CO., Organ Mts, 9 Jul 1897, *Wooton* 117 (DS, GH, NY, POM, UC, US); GRANT CO., Mangas Springs, 18 mi NE of Silver City, 15 May 1903, *Metcalfe* 66 (ARIZ, DS, NY, POM, UC [2], US); LINCOLN CO., 15 mi E of Capitan, 25 Jul 1938, *Hitchcock, Rethke & van Raadshooven* 4244 (DS, GH, UC); ROOSEVELT CO., 5 mi NE of Portales, 14 Jul 1930, *Goodman & Hitchcock* 1130 (DS, GH, NY, UC); SAN MIGUEL CO., 10 mi SE of Las Vegas, 27 Jul 1924, *Bacigalupi* 607 (DS, GH, UC); SANTA FE CO., 20 mi S of Golden, 24 Jul 1938, *Hitchcock, Rethke & van Raadshooven* 4214 (DS, GH, UC); SIERRA CO., Kingston, 29 Aug 1904, *Metcalfe* 1271 (F, GH, NY, POM, UC, US). **Oklahoma:** BEAVER CO., near Knowles, 5 May 1913, *Stevens* 325 (DS, NY, SMU, US); CIMARRON CO., Kenton, low sides of Black Mesa, 28 Jul 1936, *Demaree* 13344 (GH, NY, POM, SMU); JACKSON CO., El Dorado, 18 Apr 1936, *Demaree* 12210 (SMU, US). **Texas:** ANDREWS CO., 5 mi WSW of Andrews, 15 Sep 1966, *Shinners* 31559 (SMU); BELL CO., 2½ mi S of Nolanville, 7 Mar 1954, *C. & G. York* 54037 (SMU, TEX); BEXAR CO., 5 mi NW of San Antonio, 4 May 1948, *Burr* 135 (DS, NY [2]); BLANCO CO., 10 mi N of Johnson City, 18 Apr 1958, *Thompson & Graham* 18 (SMU, TEX); BREWSTER CO., Marathon, 15 Jul 1965, *Stuessy* 230 (TEX); BROWN CO., 7 mi S of Brownwood, 24 Apr 1966, *Guthrie* 43 (SMU, TEX); CALLAHAN CO., ca 2 mi W of Baird, 27 Mar

1963, *Henderson* 63-88 (FSU, SMU, TEX); COLEMAN CO., 1 mi SE of Santa Ana, 9 Jul 1957, *Shinners* 26390 (SMU); COMAL CO., Comanche Spring, Mar 1849, *Lindheimer* 949 (ARIZ, F, GH, NY, TEX, UC, US); COMANCHE CO., 7 mi W of Comanche, 6 Apr 1966, *Teeters* 18 (LL, SMU, TEX); CORYELL CO., 4 mi S of Gatesville, 2 Oct 1965, *Baize* 5 (LL, SMU, TEX); CROCKETT CO., 31 mi W of Ozona, 8 Jul 1965, *Stuessy* 147 (TEX); CULBERSON CO., 1 mi S of Texas-New Mexico line E of Guadalupe Mts, 14 Aug 1942, *Waterfall* 3781 (ARIZ, GH, NY); DAWSON CO., plains between Lamesa & Tahoka, 29 Apr 1925, *Small & Wherry* 12134 (NY, TEX); ECTOR CO., 5.8 mi S of Odessa, 8 May 1966, *Shinners* 31236 (SMU); EL PASO CO., 28 mi SE of El Paso, 24 Aug 1967, *Stuessy* 1127 (TEX); ERATH CO., Stephenville Pk, 9 mi N of Stephenville, 2 Apr 1950, *Shinners* 12190 (SMU); FLOYD CO., intersection of hwys 97 & 2009, 22 Apr 1962, *Melchert* 180 (TEX); GILLESPIE CO., 4.8 mi NE of Lawrence Jung Ranch, 31 Mar 1967, *Mears* 1383 (TEX); HAMILTON CO., 17 mi S of Hico, 16 Apr 1945, *Shinners* 7183 (GH, LL, SMU, UC); HARDEMAN CO., 11 mi S of Quanah, 4 Apr 1966, *Turner* 7 (LL, TEX); HAYS CO., 1.5 mi E of Dripping Springs, 30 May 1966, *Stuessy* 414 (TEX); HEMPHILL CO., 18 mi SW of Canadian, 15 Sep 1950, *Tharp & Miller* 51-312 (RSA, TEX); HUDSPETH CO., ca 20 mi N of Allamore, 29 Jul 1943, *Waterfall* 4818 (GH, NY, SMU); JEFF DAVIS CO., gravel flat between Big & Little Aguja Canyons, Davis Mts, 16 Jun 1931, *Moore & Steyermark* 3115 (DS, GH, NY, UC, US); KENDALL CO., 5 mi W of Sisterdale, 24 May 1965, *Flyr* 489 (DS, SMU); KERR CO., Kerrville, 19-25 Apr 1894, *Heller* 1632 (ARIZ, F, GH, NY [2], POM, SMU, UC [2], US); KNOX CO., 5 mi E of Benjamin, 22 Apr 1962, *Melchert* 169-C (TEX); LLANO CO., Marble, 31 Mar 1967, *Mears* 1413 (TEX); LOVING CO., 1 mi W of Mentone, 10 Jul 1965, *Stuessy* 180 (TEX); LUBBOCK CO., Lubbock, 4 May 1930, *Demaree* 7594 (DS, GH, US); NOLAN CO., Sweetwater, 5 May 1927, *Stanfield* s.n. (NY, TEX); OCHILTREE CO., 7.8 mi SE of Perryton, 13 Jul 1957, *Wallis* 4807 (ARIZ, SMU); OLDHAM CO., 16 mi N of Vega, 17 May 1967, *Turner* 5632 (TEX); PECOS CO., 10 mi E of Ft. Stockton, 19 Apr 1946, *Warnock* 46217 (FSU, TEX); POTTER CO., 1 mi N of Canadian River Bridge, 19 May 1945, *Jespersen* 2678 (DS, F, NY, SMU, UC, US); PRESIDIO CO., 7.5 mi N of Candelaria, 17 Apr 1947, *McVaugh* 7986 (DS, F, LL [2], SMU, TEX [2]); RANDALL CO., Palo Duro State Pk, 20 Oct 1945, *Cory* 50422 (GH, NY, SMU); SHACKELFORD CO., 2 mi NE of Jones Co. line, 27 Mar 1963, *Henderson* 63-93 (SMU, TEX); STEPHENS CO., 3 mi N of Ranger, 29 Apr 1939, *Culwell & Timmons* 3091 (SMU, TEX); TAYLOR CO., 5 mi SW of Abilene, 30 Jun 1962, *Turner & Melchert* 4840 (TEX); TRAVIS CO., 7 mi SW of Zilker Pk, Austin, 13 Oct 1966, *Stuessy* 752 (OS, TEX); UVALDE CO., Garner State Pk, 21 Jun 1958, *Sullivan & Turner* 34 (FSU, TEX); VAL VERDE CO., 13 mi W of Langtry, 23 Mar 1941,

Innes & Warnock 589 (DS, GH, NY, TEX); WARD CO., Barstow, 15 Apr 1902, *Tracy & Earle* 23 (F, GH, NY [2], TEX, US), WILBARGER CO., 16.9 mi S of Electra-Waggoner pastures, 12 May 1945, *Whitehouse* 9841 (SMU, TEX); WINKLER CO., 1 mi W of Kermit, 10 Jul 1965, *Stuessy* 167 (TEX).

7. **Melampodium cinereum** DC. Prodr. 5:518. 1836.

Perennial subshrubs, 14-20 cm tall. Stems suffruticose, ascending. Leaves sessile, at apex and base obtuse, at margin revolute when dry. Outer involucre cupulate; bracts 5, connate 1/6 to 1/3 their length, ovate, at apex acute, with abaxial surface strigose with hairs 0.2-1 mm long, at margin herbaceous. Fruits with lateral surfaces aculeate-verrucate. Ligules cream-white, oblong-elliptic. Disc corollas yellow. Paleae oblong-oblanceolate; apex yellow, with margin laciniate; midrib prominent, glabrous or puberulous with hairs 0.1 mm long.

7a. **Melampodium cinereum** DC. var. **cinereum**

Melampodium cinereum DC. Prodr. 5:518. 1836. TYPE: MEXICO[?]: San Fernando de las Presas, Oct 1830, *J. L. Berlandier* 2243 [=823] (Holotype, G-DC; isotypes, G! GH! K!; photograph of holotype, IDC 800. 927: II. 4!; photograph of K isotype, B! US!; photograph of G isotype, F! US!). San Fernando is a town about 83 miles SW of Matamoros, Tamaulipas, Mexico, an area visited by Berlandier (Geiser, 1948). However, this variety is known to occur only near Laredo and the surrounding territory in southcentral Texas, indicating that the locality may have been interchanged with *M. ramosissimum* as suggested by Gray (1884) and Robinson (1901).

Stems 0.8-1.3 mm diam, strigose with hairs 0.1-0.8 mm long. Peduncles 1.5-7 cm long. Leaves linear-oblong, 1.2-5.5 cm long, 0.12-1.4 cm wide, with both leaf surfaces strigose with hairs 0.2-0.6 mm long; margin entire to pinnately 10-lobed or parted, near base strigose with hairs up to 0.6 mm long. Heads 5-8 mm tall, 9-23 mm diam. Outer involucre 7-13 mm diam; bracts 3.5-7.3 mm long, 2.3-5 mm wide. Fruits 1.4-2.2 mm long; hood apex muti-

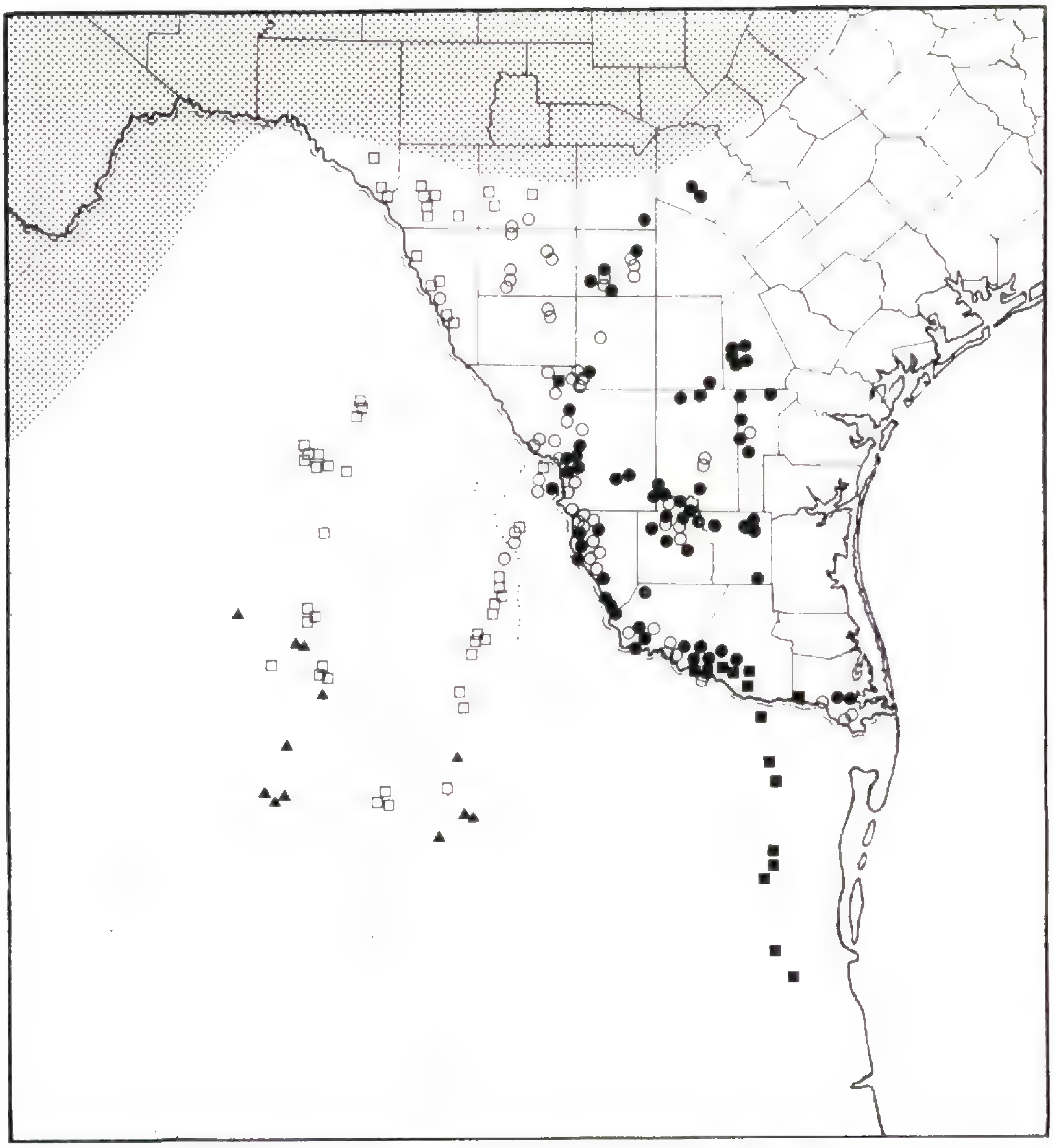

Fig. 16. Map of southern Texas and adjacent Mexico showing distribution of *Melampodium cinereum* var. *cinereum*, small form (circles), large form (dots); *M. cinereum* var. *hirtellum* (open squares); *M. cinereum* var. *ramosissimum* (closed squares); and *M. argophyllum* (triangles). Shaded area indicates generalized southeastern distribution of *M. leucanthum*.

cous to cirrhous, with appendage up to 2.2 mm long. Ray florets 7-13; ligules 3-8.2 mm long, 1-3.6 mm wide. Disc florets 30-50; corollas 1.1 mm diam, with throat 0.8 mm and tube 0.7 mm long. Paleae 2.5 mm long, 1.1 mm wide. Chromosome numbers, $n = 10$ and 20.

Mesquite-grasslands of Rio Grande Plains of Texas south to Cameron Co., east to Jim Wells Co., north to Bexar Co. and west to Maverick Co., extending into Tamaulipas and Nuevo León, Mexico, 30-240 m (Fig. 16). Flowering dates, Mar-Nov.

All the varieties of *M. cinereum* can be distinguished most easily from *M. leucanthum* and *M. argophyllum* by the outer phyllaries that are connate only 1/4 their length at the base. The outer involucral bracts of the latter two species always are fused at least 1/2 or even 2/3 their length. The usefulness of this feature has not been previously noted, but it is the best diagnostic morphological character that I have discovered for separating *M. cinereum* from the other taxa of the white-rayed complex.

Scattered within the range of var. *cinereum* are two morphological forms (small and large) that are weakly differentiated by quantitative features of habit and head size. These informal units presumably correspond to the 2*n* and 4*n* autopolyploid chromosomal races reported within this variety by Turner and King (1962) and Stuessy (1971b & c). Additional information concerning the presumptive autopolyploid origin of these races can be found in Stuessy (1971c).

REPRESENTATIVE SPECIMENS (SMALL FORM). **Mexico:** NUEVO LEÓN: S of Nuevo Laredo, 8 Jun 1935, *Clark* 6635 (NY); 15 mi N of Sabinas Hidalgo, 12 Jun 1967, *Stuessy* 854 (TEX). TAMAULIPAS: 5 km S of Nuevo Laredo, 11 Nov 1961, *Domínguez* 63 (TEX); 24 km S of Nuevo Laredo, 24 Mar 1962, *Domínguez & McCart* 8217 (SMU, TEX); 59 mi N of Sabinas Hidalgo, 12 Jun 1967, *Stuessy* 857 (TEX). UNITED STATES. **Texas:** CAMERON CO., Santa Ana National Wildlife Refuge, 26 Sep 1961, *Fleetwood* 3840 (TEX); DIMMIT CO., 3 mi W of Bigwells, 21 Apr 1945, *Shinners* 7395 (GH, LL, SMU, UC); DUVAL CO., 4 mi NE of Freer, 8 Oct 1954, *Tharp & Johnston* 541 [802A] (TEX); FRIO CO., 5.5 mi S of Pearsall, 1 May 1954, *Johnston, Tharp & Turner* 3472 (SMU, TEX); HIDALGO CO., 6 mi E of Sullivan City, 8 Mar 1959, *Turner* 4490 (TEX); JIM HOGG CO., 8 mi E of Hebbronville, 12 Jun 1952, *Jones* 719 (SMU); JIM WELLS CO., near Alice, 21 Jun 1935, *Drushel* 10441 (NY); LA SALLE CO., 1 mi W of Encinal, 21 Apr 1963, *Sánchez* 105 (SMU, TEX); MAVERICK CO., 1 mi E of Eagle Pass, 22 May 1898, *Bray* s.n. (TEX); STARR CO., 5.8 mi E of

Rio Grande City, 9 Oct 1954, *Tharp & Johnston* 541922 (TEX); WEBB CO., 22 mi NW of jct rtes 83 & 35, 5 Jul 1967, *Stuessy* 868 (TEX); ZAPATA CO., 13 mi N of San Ygnacio, 31 Jan 1954, *Shinners* 17659 (SMU); ZAVALA CO., 6 mi S of Batesville, 6 May 1964, *Turner* 5006 (SMU, TEX).

REPRESENTATIVE SPECIMENS (LARGE FORM). **Mexico:** TAMAULIPAS: 3 mi S of Nuevo Laredo, 11 Nov 1961, *Escalante* 21 (TEX); 50 mi SE of Nuevo Laredo, 28 Mar 1964, *A. & R. García* 47 (ARIZ, SMU, TEX); 12 mi SE of Nuevo Laredo, 17 Mar 1962, *C. & L. de la Garza* 46 (SMU, TEX). UNITED STATES. **Texas:** BEXAR CO., Highland Hills, San Antonio, 1 Apr 1963, *Martínez & García* 13 (SMU); BROOKS CO., 15 mi E of Hebbronville, 17 Mar 1963, *Ramírez* 44 (LL, TEX); CAMERON CO., 12 mi N of Brownsville, 18 Apr 1965, *Ríos & Cavazos* 264 (LL, SMU); DUVAL CO., 25 mi N of Hebbronville, 20 Jun 1966, *Stuessy* 429 (TEX); FRIO CO., 9 mi S of Moore, 20 Nov 1967, *Stuessy & Renold* 1284 (TEX); HIDALGO CO., 1 mi E of Sullivan City, 1 Apr 1941, *C. & A. Lundell* 9866 (LL [3], RSA); JIM HOGG CO., 5 mi E of Hebbronville, 20 Jun 1966, *Stuessy* 425 (TEX); JIM WELLS CO., 2 mi E of San Diego, 25 Nov 1962, *Dohnke* 3 (SMU, TEX); KINNEY CO., [?], Bracket [Brackettville?], 21 Mar 1900, *Canby* 133 (US); LA SALLE CO., 1 mi N of Encinal, 16 Mar 1963, *Solis* 124 (SMU, TEX); LIVE OAK CO., ca 32 mi S of Whitsett, 3 Jun 1967, *Stuessy* 771 (TEX); MCMULLEN CO., 22½ mi SW of George West, 17 Apr 1965, *Ríos & Cavazos* 231 (LL, SMU); MEDINA CO., ca 3 mi S of Devine, 28 Oct 1952, *Correll* 15204 (LL, US); NUECES CO., ca 4 mi W of Mathis, 8 May 1957, *Jones* 1359 (SMU); STARR CO., 3 mi N of Roma, 31 Jan 1954, *Shinners* 17708 (SMU); UVALDE CO., Leona River, 7 mi SE of Uvalde, 23 Jun 1935, *Munz* 13303 (POM); WEBB CO., 14 mi NE of Laredo, 9 Mar 1963, *Cisneros* 33 (LL); ZAPATA CO., 10 mi N of San Ygnacio, 7 Apr 1963, *Arzola* 178 (LL, SMU).

7b. **Melampodium cinereum** DC. var. **hirtellum** Stuessy, Sida 3:348. 1969. TYPE: MEXICO: Nuevo León, 5 km S of Sabinas Hidalgo on rd to Monterrey, 21 Apr 1939, *T. C. & E. M. Frye* 2415 (Holotype, US!; isotypes, DS! GH! NY! RSA! UC!).

Stems 0.8-1.3 diam, strigose-hispid with hairs 0.2-1.5 mm long. Peduncles 0.7-8 cm long. Leaves linear-oblong, 1.1-3.4 cm long, 0.2-1 cm wide, with both surfaces strigose with hairs 0.3-0.8 mm long, with midrib on undersurface hispid with hairs up to 1.5 mm long; margin pinnately 8-lobed or parted, near base hispid with hairs 0.4-1.5 mm long. Heads 4.5-5 mm tall, 9-18 mm diam. Outer involucre 7-10 mm diam; bracts 3.3-6 mm long, 2.2-3.6 mm wide.

Fruits 1.3-2 mm long; hood apex muticous to mucronate, with appendage up to 0.3 mm long. Ray florets 8-13; ligules 3-6 mm long, 1.3-2.8 mm wide. Disc florets 25-50; corollas 1.1 mm diam, with throat 0.7 mm and tube 0.5 mm long. Paleae 3.2 mm long, 0.9 mm wide. Chromosome number, $n = 10$.

Mesquite-grasslands in eastern Coahuila, northwestern Nuevo León and Tamaulipas, Mexico, and into Val Verde, Kinney, Uvalde and Maverick Cos. of Texas (Fig. 16), 210-520 m. Flowering dates, Feb-Oct.

REPRESENTATIVE SPECIMENS. **Mexico:** COAHUILA: Saltillo, Aug 1913, *Adole* 29 (F, GH, NY, US); Sabinas, 16 Sep 1937, *Kenoyer* 5 (F); 30 mi S of Monclova, 14 Aug 1948, *Kenoyer & Crum* 2594 (A); Muzquiz, Apr 1938, *Marsh* 1176 (F, GH, TEX); Soledad, 25 mi SW from Monclova, 9-19 Sep 1880, *Palmer* 556 (GH, NY, US); Rio Grande Valley near Diaz, 17 Apr 1900, *Pringle* 9008 (F, GH, US); 4 mi W of Nueva Rosita, 14 Aug 1967, *Stuessy* 902 (TEX); 21 mi S of Monclova on rte 57, 14 Aug 1967, *Stuessy* 912 (TEX); 23 mi N of Sabinas, 23 Aug 1959, *Waterfall* 15805 (F, SMU); Monclova, 25 mi SW of Sabinas, 19 Jun 1936, *Wynd & Muller* 214 (ARIZ, FSU, GH, NY, US). NUEVO LEÓN: Monterrey, Obispado, Jul 1911, *Abloon* 137 (US); 36 mi NE of Sabinas Hidalgo, 24 Mar 1944, *Barkley* 14575C (GH, NY); between Laredo & Monterrey, 8 Feb 1945, *Bonner* 55 (F); 12 mi N of Sabinas Hidalgo, 26 Mar 1944, *Heard & Barkley* 14542B (TEX); Cerro del Obispado, 20 Oct 1946, *Lacás* 58 (F); 8 mi S of Sabinas Hidalgo, 8 Feb 1964, *May* 13 (SMU); 12 mi W of Monterrey, 27 Feb 1944, *Painter, Lucas & Barkley* 14297 (TEX); 47 mi S of Nuevo Laredo, 28 Apr 1962, *Reséndez* 52 (SMU, TEX); 17 mi NE of Sabinas [Hidalgo], 20 Mar 1963, *Rodríguez* 72 (SMU); 26 mi N of Sabinas Hidalgo, 12 Jun 1967, *Stuessy* 855 (TEX); 38 mi N of Sabinas Hidalgo, 12 Jun 1967, *Stuessy* 856 (TEX). UNITED STATES. **Texas:** KINNEY CO., 9 mi W of Brackettville, 28 Mar 1947, *McVaugh* 7694 (DS, F, LL [2], SMU, TEX); MAVERICK CO., 30 mi SE of Eagle Pass, 14 Mar 1964, *Bruni* 15 (LL, SMU, TEX); UVALDE CO., 2 mi N of Cline, 8 Jul 1936, *Hedrick* 156 (UC); VAL VERDE CO., Del Rio, 20 Apr 1930, *Jones* 25916 (DS, POM).

7c. **Melampodium cinereum** DC. var. **ramosissimum** (DC.) A. Gray, Smithson. Contrib. Knowledge 3, Art. 5: 103. 1850.

Melampodium ramosissimum DC. Prodr. 5:518. 1836. TYPE: TEXAS[?]: between the Nueces River & Laredo,

Jul 1829, *J. L. Berlandier* 2017 [=607] (Holotype, G-DC; isotypes, F! G! GH[2]! HAL! K! MO[2]! W[2]! WIS!; photograph of holotype, IDC 800. 927: II. 1!; photograph of K isotype,US!; photograph of HAL isotype, OS! TEX!).

Melampodium cinerascens S. F. Blake, Contrib. U. S. Nat. Herb. 22:605. 1924. TYPE: MEXICO: Tamaulipas, Hacienda Buena Vista, ca 20 mi E of Abasolo, 18 Jun 1919, *E. O. Wooton* s.n. (Holotype, US!; photograph of holotype, TEX!).

Stems 0.7-0.8 mm diam, strigose with hairs 0.1-0.8 mm long. Peduncles 0.7-3.8 cm long. Leaves linear, 0.7-3.2 cm long, 0.2-0.5 cm wide, with both leaf surfaces strigose with hairs 0.2-1 mm long; margin entire to pinnately 10-lobed or cleft, near base strigose with hairs up to 1 mm long. Heads 3-5 mm tall, 5-14 mm diam. Outer involucre 4.5-9 mm diam; bracts 2.7-4 mm long, 1.3-2.8 mm wide. Fruits 1.5-1.7 mm long; hood apex mucronate to cirrhous (rarely muticous), with appendage up to 1.5 mm long. Ray florets 7-8; ligules 2-3.8 mm long, 1-2.3 mm wide. Disc florets 25-35; corollas 1.3 mm diam, with throat and tube each 0.4 mm long. Paleae 2.5 mm long, 0.9 mm wide. Chromosome number, $n = 10$.

Mesquite-grasslands of northern Tamaulipas, Mexico, and adjacent Hidalgo, Cameron and Webb Cos. of Texas (Fig. 16), 15-90 m. Flowering dates, Jun-Dec.

There is some character intergradation where the three varieties of *M. cinereum* overlap near the Rio Grande Valley of southern Texas (Fig. 16). Although no detailed studies have been carried out to clarify the nature of this intergradation, hybridization is likely to be occurring.

REPRESENTATIVE SPECIMENS. **Mexico.** TAMAULIPAS: 20 mi E of San Fernando-Santander Jiménez hwy on rd to Loreto (11 mi W of Loreto), 15 Sep 1960, *Crutchfield & Johnston* 5527 (TEX); 13 mi E of Abasolo turnoff on the Santander-Jiménez-Pesca rd, 15 Dec 1960, *Crutchfield & Johnston* 6141b (TEX); 48 mi S of Reynosa, 19 Oct 1959, *Graham & Johnston* 4378 (TEX); 1 mi N of San Fernando, 4 Jul 1966, *Stuessy* 450 (TEX); ca 2 mi SE of Reynosa, 4 Jun 1967, *Stuessy* 778 (TEX); 27 mi S of Reynosa, 4 Jun 1967,

Stuessy 787 (TEX); 3 mi S of San Fernando, 18 Nov 1967, *Stuessy & Renold* 1261 (TEX). UNITED STATES. **Texas:** HIDALGO CO., Mission, Lomita Alta, 13 Jul 1937, *Cameron* 248 in part (TEX); McAllen, 10 Aug 1937, *Cameron* 248 in part (TEX); La Joya gravel pit, 27 Aug 1942, *Walker* 93 (LL, TEX); WEBB CO., 11 mi W of Encinal, 5 Jul 1960, *H. & F. Iltis & Koeppen* 35 (WIS).

8. **Melampodium argophyllum** (A. Gray ex Robins.) S. F. Blake, Contrib. U. S. Nat. Herb. 22:606. 1924.

Melampodium cinereum DC. var. *argophyllum* A. Gray ex Robins. Proc. Amer. Acad. Arts & Sci. 36:458. 1901. (A. Gray in S. Wats. Proc. Amer. Acad. Arts & Sci. 18: 104. 1883. *nom nud.*, but based on the type collection) TYPE: MEXICO: Coahuila Sierra Madre S of Saltillo [ca 60 km SE of Saltillo; McVaugh, 1956], Feb-Oct 1880, *E. Palmer* 2068 (Holotype, GH!).

Melampodium leucanthum Torr. & A. Gray var. *argophyllum* (A. Gray ex Robins.) Stuessy, Sida 3:348. 1969.

Perennial subshrubs, 12-22 cm tall. Stems ascending, 0.8-1.2 mm diam, canescent-tomentose with hairs 0.2-1 mm long. Peduncles 3.5-7.7 cm long. Leaves sessile, linear-oblong, 1-2.8 cm long, 0.2-1.5 cm wide, at apex and base obtuse, with both surfaces tomentose with hairs 0.2-1 mm long; margin pinnately 8-lobed or parted (rarely entire), near base strigose-hispid with hairs 0.5-0.7 mm long. Heads 4-7 mm tall, 10-23 mm diam. Outer involucre cupulate, 6.2-12 mm diam; bracts 5, connate 1/2 to 3/5 their length, ovate, 3.5-6 mm long, 2.5-5 mm wide, at apex acute, with abaxial surface tomentose with hairs 0.1-1 mm long; margin herbaceous. Fruits 0.8-1.9 mm long, with lateral surfaces aculeate-verrucate; hood apex muticous to cirrhous (usually mucronate). Ray florets 8-9; ligules cream-white, oblong-elliptic, 2.5-9 mm long, 1.5-4.5 mm wide. Disc florets 25-50; corollas yellow, 1 mm diam, throat and tube each 0.8 mm long. Paleae oblong-elliptic, 2.6 mm long, 1.2 mm wide; apex yellow, with margin laciniate; midrib prominent, often strigillose with hairs 0.1 mm long. Chromosome number unknown.

Arid mountains in western Nuevo León and adjacent Coahuila, Mexico (Fig. 16), 1830-2440 m. Flowering dates, Feb-Oct.

Although *M. argophyllum* was first described as a variety of *M. cinereum*, in subsequent years the status of the former taxon has been changed twice. Morphologically *M. argophyllum* shows similarity to both *M. leucanthum* and *M. cinereum* but seems to have a greater total resemblance to the former species. Due to recent chromatographic studies on *M. argophyllum* and other taxa of the white-rayed complex (Stuessy, 1971c), however, I have reversed my earlier judgment (1969a) based solely on morphological criteria which treated *M. argophyllum* as a variety of *M. leucanthum*. I now concur with Blake's (1924) recognition of *M. argophyllum* as being a distinct species. Refer to my recent paper (1971c) for additional discussions on the status of *M. argophyllum* and on hypothetical evolutionary relationships within the entire white-rayed complex.

REPRESENTATIVE SPECIMENS. **Mexico.** COAHUILA: G. Cepeda, Sierra de la Paila (V. Seco), 6 Jul 1944, *Hinton et al.* 16563 (GH, NY, US); 45 km SW of Monterrey, 28 Feb 1946, *Johnson & Barkley* 16250M (TEX); Castaños, "Puerto de San Lázaro," Sierra de San Lazar, 30 Aug 1939, *Muller* 3040 (F, GH, UC); Sierra de la Pata Solana, Mar 1905, *Purpus* 1003 (F, GH, NY, UC), Feb 1905, *Purpus* 1003a (UC); Sierra de la Paila, Oct 1910, *Purpus* 4730 (UC); Sierra de Parras, Mar 1905, *Purpus* s.n. (UC); Cañon Espantosa, W slope of Sierra de San Vicente, ca 20 km ESE of Cuatro Cienegas, 25 Mar 1941, *Schroeder* 120 (GH); 9 km S of Parras on Sierras Negras, 3 Jul 1941, *Stanford, Retherford & Northcraft* 186 (ARIZ, DS, F, GH, NY [2], UC); Castaños, San Lázaro, "rocky slopes of El Puerto de San Lázaro," 16 Jun 1936, *Wynd & Muller* 132 (ARIZ, US). NUEVO LEÓN: Las Salinas, 1924, *Orcutt* 1395 (US); 24 km W of Icamole, 3 Feb 1907, *Safford* 1264 (US).

3. Series **Sericea** Stuessy, ser. nov.

Herbae annuae; folia lanceolata vel pinnatim divisa, subtus sericea vel strigosa; ligulae luteae, minus quam vel raro circa 2 mm longae; involucrum extimum marginibus herbaceis; fructi plerumque cucullati. Species 9-13. Typus: *Melampodium sericeum* Lag.

9. **Melampodium sericeum** Lag. Gen. et Sp. Nov. 32. 1816. *non* H.B.K. 1820. TYPE: "NOVA HISPANIA": 1787-1804, seeds collected by *M. Sessé & J. M. Mociño* s.n. (Holotype, MA?; isotype, G!; photograph of G isotype, F! OS! TEX! US!; photograph of G-DC isotype, IDC 800. 937: I. 8!).

Melampodium hispidum H.B.K. Nov. Gen. Sp. 4:273. *t. 399.* 1820. TYPE: MEXICO: Michoacán, between Pázcuaro & Valladolid [Morelia], 6000 ft, Sep 1803, *F. H. A. von Humboldt & A. J. Bonpland* s.n. (Holotype, P; fragments of holotype, P!).

Melampodium sericeum Lag. var. *brevipes* A. Gray, Proc. Amer. Acad. Arts & Sci. 22: 423. 1887. TYPE: MEXICO: Guanajuato, León, W of Guanajuato, 1829, *"Menzies"* [probably *J. Méndez*] s.n. (Holotype, GH!; photograph of G-DC isotype, TEX!; tracing of probable isotype [G?], GH!).

Melampodium sericeum Lag. var. *exappendiculatum* Robins. Proc. Amer. Acad. Arts & Sci. 36:459. 1901. TYPE: MEXICO: San Luis Potosí, "in mountains near Morales," Aug 1876, *J. G. Schaffner* 271 (Lectotype chosen, GH!).

Annual herbs, 3-40 cm tall. Stems ascending to erect, 0.4-2.5 mm diam, hispid-pilose with hairs up to 1 mm long. Peduncles 5-22 mm long. Leaves sessile, linear-oblong to oblanceolate, 2-6.5 cm long, 0.2-3 cm wide, at apex acute-obtuse, at base attenuate to obtuse, with upper surface strigose with hairs 0.5 mm long, with lower surface sericeous; margin entire to pinnately parted with 1-4 lobes, irregularly ciliate with hairs 0.2 mm long, at base hispid with hairs 1-1.5 mm long. Heads 4-5 mm tall, 4-8 mm diam. Outer involucre cupulate, 6-11 mm diam; bracts 5, slightly connate at base, separate to imbricate, narrowly rhombic to obovate, 3-7 mm long, 2-4 mm wide, at apex acute, with abaxial surface pilose to hispid with hairs 1-1.5 mm long; margin herbaceous. Fruits 2.5-3.2 mm long, with lateral surfaces smooth and striate to strongly verrucate; hood apex muticous to cirrhous, with tapering appendage up to 2 mm long. Ray florets 5-7; ligules yellow, narrowly ovate, 0.8-1.2(2.2) mm long, 0.6-0.8(–1.2) mm wide. Disc florets
Cruz, Sep 1851, *G. Thurber* 937 (Lectotype, GH! K! MO!

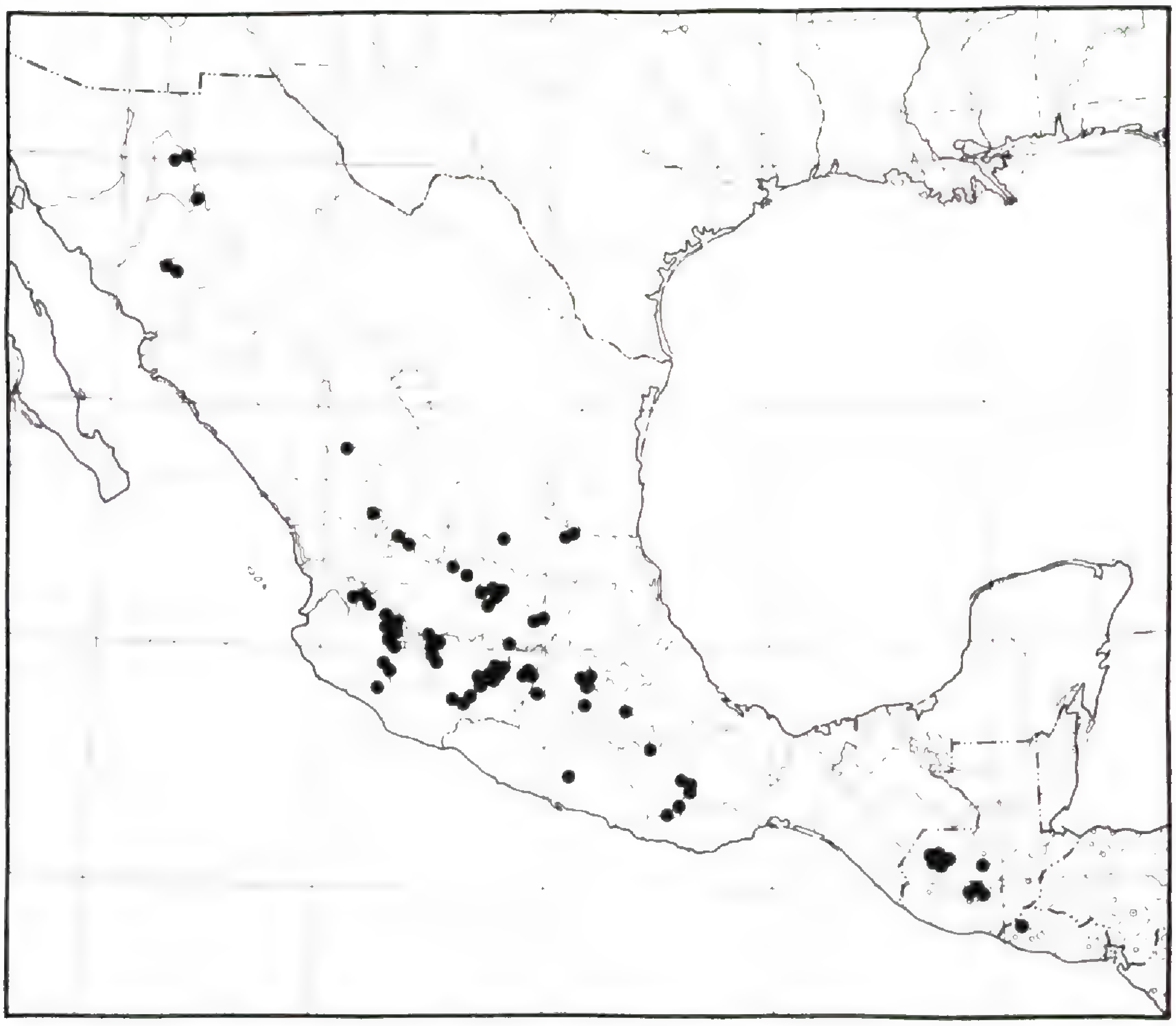

Fig. 17. Map of Mexico and adjacent Central America showing distribution of *Melampodium sericeum*.

(–5)8-12; corollas yellow, 1.1 mm diam, with throat 0.6 mm and tube 0.5 mm long. Paleae oblanceolate, 3.5 mm long, 0.3 mm wide; apex yellow, with margin dentate-erose; midrib prominent, glabrous. Chromosome number, $n = 30$.

Pine-oak forests of Mexico, Guatemala and El Salvador (Fig. 17), 1100-2590 m. Flowering dates, Jul-Sep.

This is a widespread, variable species. Although no varieties are recognized here in *M. sericeum*, there are several morphologically distinct collections that should be noted. One specimen from Guatemala, *Steyermark* 50530, is unusually robust and has brown-purple disc florets. Also from Guatemala are several collections, *Morales* 1300, *Rojas* 86, *Standley* 59769 and 82849, which possess fruits with

broad, wide-spreading hoods in contrast to the much narrower hoods typical of the species.

REPRESENTATIVE SPECIMENS. **El Salvador.** SANTA ANA: near Chalchuapa, 1922, *Calderón* 1019 (GH, US). **Guatemala.** BAJA VERAPAZ: Santa Rosa, Oct 1912, *Tuerckheim* 3955 (US). ESCUINTLA: 1942, *Ignacio* 1567 (F). GUATEMALA: Laguna, Amatitlán, 1929, *Morales* 1300 (F); Chilloni, 21 Jun 1921, *Rojas* 86 (GH, NY, US); Finca Bretaña, rd between Guatemala & Riscal, 12 Dec 1938, *Standley* 59769 (F, NY, SMU). HUEHUETENANGO: ca 3 mi S of Huehuetenango, 18 Jul 1960, *King* 3416 (NY, TEX, UC); Huehuetenango, 9 Nov 1934, *Skutch* 1592 (GH); between San Sebastián H. & Río San Juan, 9 Jan 1941, *Standley* 82849 (F, NY, US); between Huehuetenango & San Sebastián H., 12 Aug 1942, *Steyermark* 50392 (F, GH, US); between San Sebastián H. & San Rafael Pétzal, 14 Aug 1942, *Steyermark* 50530 (F). QUICHÉ: 1942, *Ignacio* 1404 (F). **Mexico.** CHIHUAHUA: La Mesa Colorada, 14 Oct 1939, *Gentry* 550 [550M] (ARIZ, DS, F); Loreto, Río Mayo, 1 Sep 1936, *Gentry* 2553 (ARIZ, GH, F, UC, US); Temosachic, Cañón Huahuatán, 10 mi SE of Madera, 23 Sep 1939, *Muller* 3434 (GH, UC). COLIMA: Alzada, 25 Aug 1966, *Stuessy* 730 (TEX). DISTRITO FEDERAL: Olivar, 15 Aug 1910, *Orcutt* 3605 (F); above Santa Fe, 4 Sep 1901, *Pringle* 8609 in part (F, GH, NY, POM, UC, US [2]). DURANGO: vicinity of Durango, Iron Mt, Oct 1896, *Palmer* 926 (GH, US). GUANAJUATO: 20 mi NE of Irapuato, 28 Aug 1947, *Barkley, Rowell & Paxson* 735 (TEX); near Guanajuato, Sep [year?], *Dugès* 44 (GH [2]); Guanajuato, 1909, *Furness* s.n. (F); near Acambaro, 6 Oct 1892, *Pringle* 5309 (GH); 14 mi SE of León, 16 Aug 1957, *Waterfall & Wallis* 13886 (F, SMU). GUERRERO: Petaquillas, 27 Aug 1965, *Stuessy* 364 (TEX). JALISCO: 56 mi SE of Guadalajara, 21 Aug 1953, *W. & M. Manning* 531212 (GH, TEX); ca 11 mi SE of Lagos de Moreno, 7 Sep 1952, *McVaugh* 12822 (SMU, US); Guadalajara, Jul 1886, *Palmer* 260 (GH, US); near Guadalajara, 24 Aug 1901, *Rose & Hay* 6275 (GH, US); 2 mi NW of Tequila, 26 Aug 1966, *Stuessy* 740 (TEX). MÉXICO: Temascaltepec, Plaza de Gallos, 22 Jul 1934, *Hinton et al.* 6324 (GH, NY, US). MICHOACÁN: ca 10 mi W of Morelia, 5 Aug 1960, *King* 3626 (DS, NY, TEX, UC, US); Cerro Potrerillos, ca 5 mi N of Cotija, 5-9 Oct 1961, *King & Soderstrom* 4584 (NY, SMU, TEX, UC, US); 0.8 mi NW of Zitacuaro, 1 Sep 1965, *Stuessy* 377 (TEX); 7 mi S of Ario de Rosales, 20 Aug 1966, *Stuessy* 690 (TEX); 11 mi NW of Zamora, 23 Aug 1966, *Stuessy* 703 (TEX). MORELOS: Cuernavaca, 31 Aug 1910, *Orcutt* 3887 (F). NAYARIT: 5 mi SE of Ixtlán del Río, 16 Aug 1961, *Waterfall* 16342 (SMU, UC). OAXACA: 53 mi S of Tehuacán, 13 Aug 1961, *Powell & Edmondson* 660 (F, TEX); Valley of Oaxaca, 5 Jul 1897, *Pringle* 6728 (F, GH, NY, UC, US [2]); 38 mi S of Zimatlán, 12 Aug 1966,

Stuessy 642 (TEX); 4 mi S of Sola de Vega, 13 Aug 1966, *Stuessy* 647 (TEX); ½ mi NW of Las Sedas, 15 Aug 1966, *Stuessy* 660 (TEX). PUEBLA: Los Molinos between Puebla & Atlixco, 18 Sep 1944, *Sharp* 44961 (NY). QUERÉTARO: Jul 1904, *Kuntze* 27465 (NY [2]); 6 mi W of Querétaro, 6 Aug 1961, *Powell & Edmondson* 579 (F, TEX); 4.7 mi N of Querétaro, 8 Aug 1959, *Rock* M-442 (TEX). SAN LUIS POTOSÍ: 15-16 mi E of Ciudad del Maiz, 20 Sep 1960, *Crutchfield & Johnston* 5664 (TEX); 3 mi E of Ciudad Maiz, 2 Sep 1948, *Kenoyer & Crum* 4093 (GH); near San Luis Potosí, 1877, *Schaffner* 270 in part (NY). SONORA: ca 2 mi W of Tres Ríos (ca 88 mi W of Vieja Casa Grandes, Chihuahua), 29 Aug 1952, *Tucker* 2565 (ARIZ, US); Cañón de Huépari, N of Aribabi, 2-3 Sep 1939, *White* 2642 in part (GH). ZACATECAS: between Colotlán & Plateado, 31 Aug 1897, *Rose* 3617 (F, US).

10. **Melampodium pringlei** Robins. Proc. Amer. Acad. Arts & Sci. 36:461. 1901. TYPE: MEXICO: Oaxaca, Las Sedas, 1850 m, 15 Sep 1894, *C. G. Pringle* 5722 (Holotype, GH!).

Annual herbs, 30 cm tall. Stems ascending, 1-2 mm diam, hirsute-hispid with hairs up to 1 mm long. Peduncles 1-2 mm long. Leaves sessile, linear-oblong to oblanceolate, 2-2.8 cm long, 0.7-1.6 cm wide, at apex acute-obtuse, at base attenuate to obtuse, with upper surface strigose with hairs 1 mm long, with lower surface copiously sericeous; margin entire to 2-lobed, irregularly ciliate with hairs 0.3 mm long, near base hirsute with hairs 1-2 mm long. Heads 3-4 mm tall, 3.5-4 mm diam. Outer involucre cupulate, 3-4 mm diam; bracts 5, slightly connate at base, separate, lanceolate, 3-3.5 mm long, 1 mm wide, at apex acute-acuminate, with abaxial surface hirsute with hairs 1 mm long; margin herbaceous. Fruits 3 mm long, with lateral surfaces 3-ribbed with large tubercles. Ray florets 3-4; ligules yellow, with undersurface near apex light purple, ovate, 1 mm long, 0.5 mm wide. Disc florets 2-3; corollas yellow, 1.1 mm diam, with throat 0.6 mm and tube 0.5 mm long. Paleae oblanceolate, 2.5 mm long, 0.8 mm wide; apex purple, with margin erose-dentate; midrib prominent, weakly pilose with hairs 0.3 mm long. Chromosome number unknown.

Known only from the type collection from pine-oak forests near Las Sedas, Oaxaca, Mexico (Fig. 11), 1860 m. Flowering date, Sep.

Although this taxon is very similar to *M. sericeum*, it seems sufficiently distinct to be maintained as a separate species at the present time. Additional collections, however, may indicate that varietal status is preferable. I have searched the countryside around Las Sedas, the type locality, but have been unsuccessful in rediscovering the taxon. Characters (in addition to those listed in the key) which distinguish *M. pringlei* from its closeset relative are:

M. sericeum	*M. pringlei*
1. Heads 4-5 mm tall, 4-8 mm diam.	1. Heads 3-4 mm tall, 3.5-4 mm diam.
2. Outer involucral bracts narrowly rhombic to obovate, 3-7 mm long, 2-4 mm wide.	2. Outer involucral bracts lanceolate, 3-3.5 mm long, 1 mm wide.
3. Ray florets 5-7.	3. Ray florets 3-4.
4. Paleae yellow-tipped.	4. Paleae purple-tipped.

11. **Melampodium strigosum** Stuessy, sp. nov.

Melampodium coronopifolium Sch. Bip. ex Hemsl. Biol. Centr. Am. Bot. 2:145. 1881. *nom. nud.* Based on several specimens including *C. C. Parry & E. Palmer* 444 1/2 (GH! K! MO! NY! US!).

Herbae annuae, 3-35 cm altae. Caules ascendentes, 0.6-2 mm diametro, moderate hispido-strigillosi, pilis 0.3-1 mm longis. Pedunculi 0-3(–11) mm longi. Folia sessilia, oblongo-linearia vel oblanceolata, 0.6-5 cm longa, 0.2-1.5 cm lata, apice acuto-obtusa, basi obtuso-subauriculata, utrinque strigosa pilis 0.2-0.6 mm longis, marginibus integris vel pinnatim 2-4 lobatis, basalibus strigoso-hispidis, pilis 0.3-1.1 mm longis. Capitula 3-4 mm alta, 4-8 mm diametro. Involucrum extimum cupulatum, 3-8 mm diametro; bracteae 5, basi leviter connatae, separatae, lanceolato-ellipticae, 2.7-6 mm longae, 1-2.9 mm latae, apice acutae, extus strigoso-hispidae in nervis principalibus, pilis 0.3-0.8 mm longis, marginibus herbaceis. Fructus 2.2-3 mm longi, lateribus striatis vel verrucatis, cucullis apice muticis vel cirrhosis,

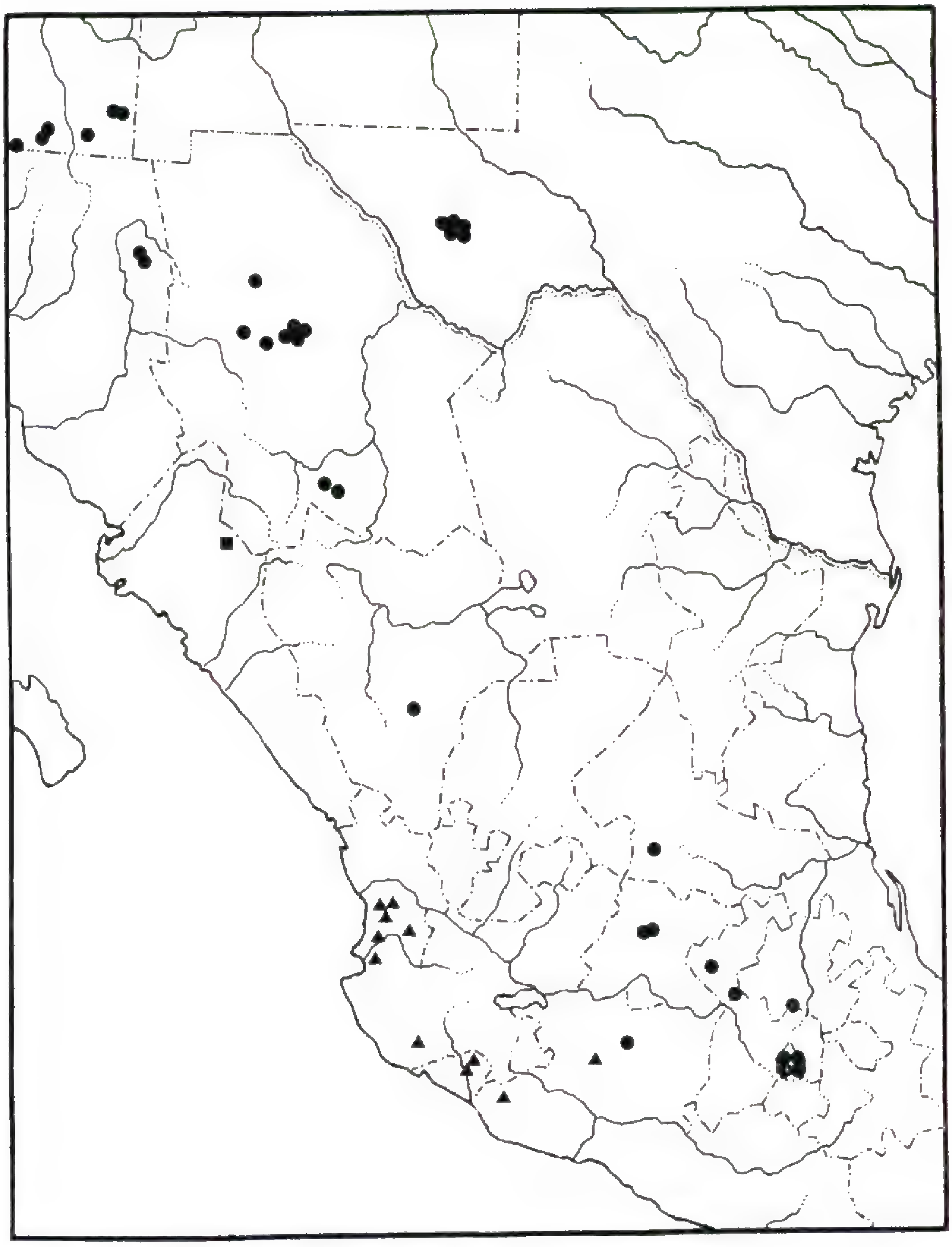

Fig. 18. Map of Mexico and adjacent United States showing distribution of *Melampodium strigosum* (dots), *M. sinaloense* (square), and *M. tepicense* (triangles). One collection of *M. strigosum* from Colorado not shown.

mucrones 2-2.5 mm longis. Flosculi radii 5-8; ligulae flavae, oblongo-ovatae, 0.6-1.1 mm longae, 0.5-0.8 mm latae. Flosculi disci 4-6; corollae flavae, 1-2 mm diametro, faucibus 0.6 et tubis 0.5 mm longis. Paleae oblongo-ellipticae, 2.3 mm longae, 0.8 mm latae, apice flavae, marginibus dentatis, costis conspicuis, glabris vel puberulis pilis 0.1 mm longis. Chromosomatum numerus, $n = 20$.

TYPUS: MEXICO: Chihuahua, ca 5 mi E of Ciudad Guerrero on rte 16, 21 Aug 1967, *T. F. Stuessy* 1054 (Holotype, US!; isotypes, F! GH! MICH! NY! OS! SMU! TEX! UC!).

Pine-oak forests of central and northwestern Mexico, reaching Cochise, Pima and Santa Cruz Cos. of southeastern Arizona, Jeff Davis Co. of Texas, and Chaffee Co. of Colorado (Fig. 18), 1310-2590 m. Flowering dates, Aug-Oct.

This new species is a common taxon that has masqueraded under the name of *M. hispidum* H.B.K. for many years. Dr. Rogers McVaugh first mentioned to me that the holotype of *M. hispidum* in the herbarium at Paris seemed conspecific with the even more common species, *M. sericeum* Lag. Having obtained additional information from Dr. Alicia Lourteig at Paris regarding the holotype of *M. hispidum*, I believe it is definitely conspecific with *M. sericeum*.

The placement of *M. hispidum* in synonymy with *M. sericeum* leaves *M. coronopifolium* Sch. Bip. ex Hemsl. as the only other name applicable to this taxon, but this latter epithet is a *nomen nudum* and therefore not validly published. By reference to three specimens cited in the protologue as being representative, however, *M. coronopifolium* is clearly referable to this species. I could now validate this available epithet, but I prefer to name this undescribed species with an epithet that emphasizes the distinctive strigose pubescence of the leaves in contrast to the markedly sericeous leaves of the morphologically similar *M. sericeum*.

REPRESENTATIVE SPECIMENS. Mexico. CHIHUAHUA: Parral, 19 Sep 1898, *Goldman* 110 (NY, US); San Diego Canyon, Sierra Madre Mts, 16 Sep 1903, *Jones* s.n. (POM); Sta Clara Mts, 10-19 Oct 1935,

LeSueur 341 (ARIZ, F, GH, TEX); near Chihuahua, Sep-Oct 1885, *Pringle* 297 (F, GH, NY, US [2]), 1 Jun 1885, *Pringle* 10 (F, GH, K, NY [2], US); mts near Chihuahua, Sep 1886, *Pringle* 754 (F, NY [2], UC [2], US [2]); near Chihuahua, 12 Sep 1886, *Pringle* 1045 (DS, NY, UC); ca 2-3 mi W of Parral, 18 Aug 1967, *Stuessy* 1016 (TEX); 2 mi S of Cuauhtémoc, 20 Aug 1967, *Stuessy* 1038 (TEX); near Colonia García in Sierra Madre Mts, 26 Sep 1899, *Townsend & Barber* 351 (GH, NY, US). DISTRITO FEDERAL: Pyramid of Cuicuilco, Tlalpán, 1 Sep 1936, *MacDaniels* 747 (F); Valley of Mexico, 9 Sep 1896, *Pringle* 6491 (F, GH, NY, UC, US); above Santa Fe, Valley of Mexico, 4 Sep 1901, *Pringle* 8609 in part (GH); near Club Golf de Chapultepec, 4 Sep 1946, *Zamora, Paxon & Barkley* 16M905 (TEX). DURANGO: vicinity of Durango, Apr-Nov 1896, *Palmer* 486 (F, GH, NY, UC, US). GUANAJUATO: Guanajuato, Aug 1899, *Dugès* s.n. (US); Guanajuato, 1909, *Furness* s.n. (F). HIDALGO: near El Salto, 17 Sep 1901, *Pringle* 9331 (GH, NY, US); near Landa Station, 3 Sep 1903, *Pringle* 11548 (ARIZ, F, GH, SMU, US). QUERÉTARO: 22 mi NE of San Juan del Río, 10 Sep 1962, *Turner & Powell* 1116 (TEX); 14 mi SE of San Juan del Río, 17 Aug 1957, *Waterfall & Wallis* 13960 (SMU, US). SONORA: Cañón de Huépari N of Aribabi, 2-3 Sep 1939, *White* 2642 in part (ARIZ), 7 Sep 1939, *White* 2788 (DS). UNITED STATES. **Arizona:** COCHISE CO., Chiricahua Mts, 18 Sep 1907, *Blumer* 1665 (ARIZ, F, GH, NY, US); Portal, Chiricahua Natl Forest, 17-19 Sep 1914, *Eggleston* 10729 (US); Lanner Canyon, Huachuca Mts, 24 Aug 1910, *Goodding* 814 (ARIZ, GH, US); Huachuca Mts, 20 Aug 1893, *Holzner* 1962 (US); Chiricahua Mts, 22 Sep 1931, *Jones* s.n. (POM); Huachuca Mts, near Ft Huachuca, Sep 1882, *Lemmon* 2777 (F, GH, K, NY, UC); PIMA CO., Rincon Mts, Dec 1907, *Goodding* 13 (ARIZ); SANTA CRUZ CO., Nogales, 23 Oct 1926, *Jones* 22681 (POM); Patagonia Mts, 18 Aug 1928, *Kearney* 5587A (US); Nogales, 7 Aug 1927, *Peebles, Harrison & Kearney* 4614 (US). **Colorado:** CHAFFEE CO., Buena Vista, *Jones* s.n. (POM). **Texas:** JEFF DAVIS CO., Davis Mts, Madera Canyon, Aug 1936, *Hinckley* 620 (NY), 3 Oct 1936, *Hinckley* 881 (ARIZ, F, GH, LL, NY [2], SMU); Davis Mts, Madera Creek, old Fisher Ranch House, 16 Sep 1944, *Hinckley* 3293 (LL, US); Madera Canyon, Mt Livermore, Aug 1936, *Hinckley* s.n. (TEX); Madera Canyon, Davis Mts, 25 Aug 1967, *Stuessy* 1128 (TEX); 11 Sep 1959, *Turner* 4620 (SMU, TEX); N of Merrill ranch on rd to Mt Locke, 13 Aug 1950, *Warnock* 9229 (SMU); upper Madera Canyon, Davis Mts, 5 Oct 1955, *Warnock* 13507 (LL); Davis Mts, 18 Sep 1918, *Young* s.n. (TEX).

12. **Melampodium longicorne** A. Gray, Mem. Amer. Acad. ser. 2. 5:321. 1855. TYPE: MEXICO: Sonora, near Santa

Cruz, Sep 1851, *G. Thurber* 937 (Lectotype, GH!; isotypes, GH! K! MO! NY!; photograph of K isotype, US!).

Annual herbs, 12-60 cm tall. Stems erect, 0.9-2.8 mm diam, subglabrous to hispid-strigose with hairs 0.5-1 mm long. Peduncles 4-30 mm long. Leaves sessile, linear-oblong to oblanceolate, 3-5 cm long, 0.3-1.2 cm wide, at apex obtuse, at base truncate-subauriculate, with both surfaces strigose with hairs 0.3-0.8 mm long; margin entire to obscurely dentate, at base hispid-hispidulous with hairs 0.5-1 mm long. Heads 4-7 mm tall, 7-13 mm diam. Outer involucre cupulate, 6-8(–10) mm diam, bracts 5, slightly connate at base, usually imbricate 2/3 their length (less often separate), elliptic to obovate-rhombic, 4.3-6.8 mm long, 2-4 mm wide, at apex acute, with abaxial surface moderately strigose with hairs 0.5-1 mm long; margin herbaceous. Fruits 3-3.6 mm long, with lateral surfaces granulate to aculeate-verrucate; hood apex cirrhous, with appendage over 4 mm long. Ray florets 7-12; ligules yellow, oblong-elliptic, 1.2-1.5 mm long, 0.7-0.9 mm wide. Disc florets 8-10; corollas yellow, 1 mm diam, with throat 0.5 mm and tube 0.4 mm long. Paleae oblong-elliptic, 3.4 mm long, 1.1 mm wide; apex yellow, with margin bidentate; midrib prominent, strigillose with hairs 0.1 mm long. Chromosome number, $n = 30$.

Mountains of southeastern Arizona in Cochise, Pima and Santa Cruz Cos., and in adjacent Sonora, Mexico (Fig. 19), 1130-1830 m. Flowering date, Sep.

Found exclusively in southeastern Arizona and neighboring Sonora, this species is often conspicuous with its long coiled awns on the hoods of the ray achenes. Just as often, however, the awns are absent, making separation from the morphologically similar *M. strigosum* difficult. In the area of sympatry in Arizona, there is a trend in *M. strigosum* toward longer peduncles, more entire leaves, and more erect stems, suggesting that hybridization may be occurring between the two taxa.

Asa Gray seems to have experienced some difficulty in delimiting *M. longicorne*, even though he himself described

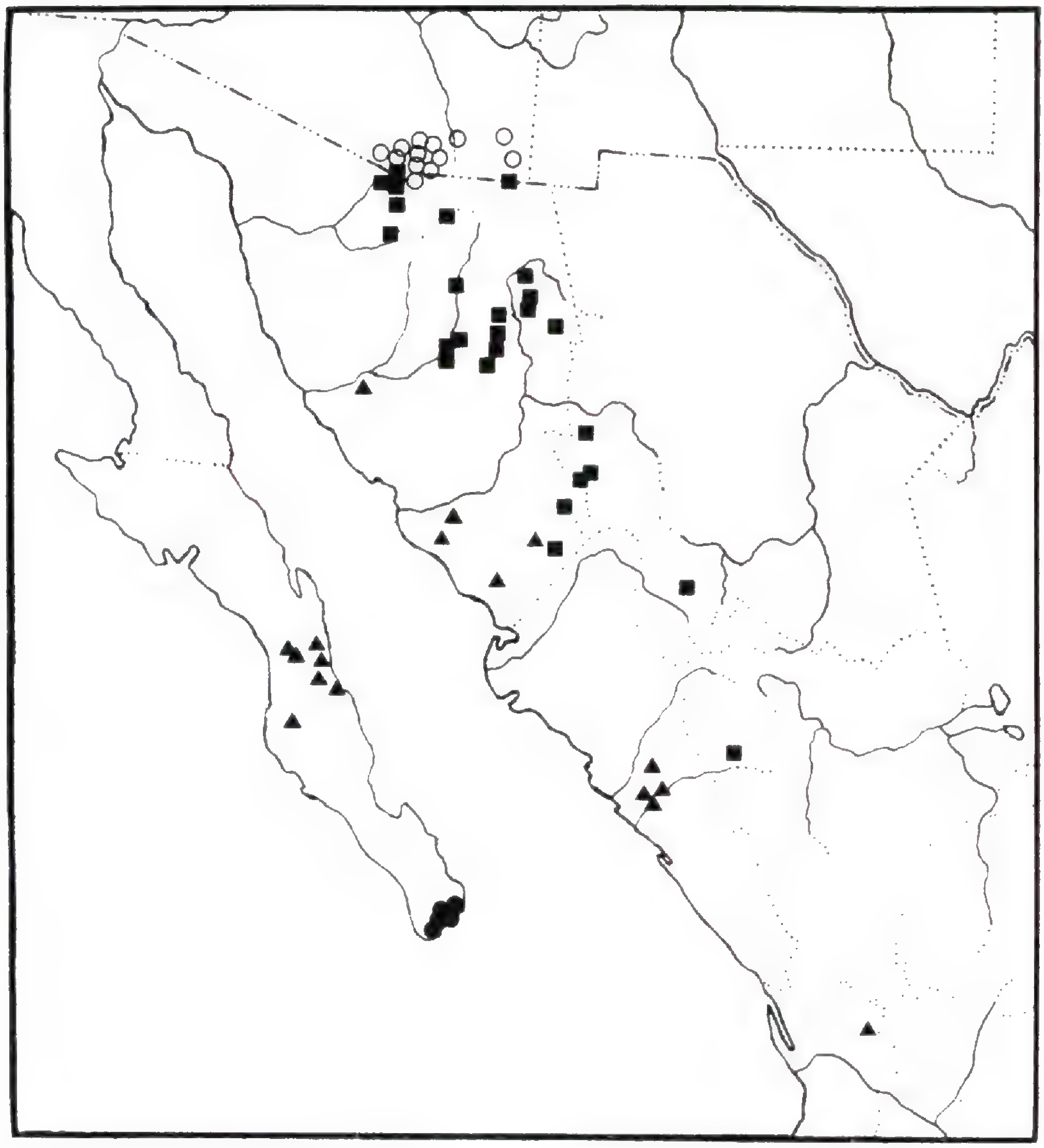

Fig. 19. Map of northwestern Mexico and adjacent United States showing distribution of *Melampodium appendiculatum* (squares), *M. cupulatum* (triangles), *M. longicorne* (circles), and *M. sinuatum* (dots).

it as new. He first (1855) confused a *Wright* 1205 collection (distinct *M. longicorne*) with *M. strigosum* and later (1859) emended his original description to include a *Schott* 72 collection, the latter being treated subsequently as belonging to *M. appendiculatum* (Robinson, 1901; present treatment).

Confusion has existed regarding the correct spelling of the specific epithet, and some workers (Robinson, 1901; Tidestrom and Kittell, 1941; Gentry, 1942) have elected to use the form *longicornu* rather than *longicorne* as originally published. Even Gray himself ceased to use the original adjectival spelling and reverted to the substantive form *longicornu* in his subsequent publications of 1859 and 1884. However, as *longicorne* is the original correct spelling, I have used this form in the present treatment, as have other workers in recent times (Kearney and Peebles, 1942, 1964; Shreve and Wiggins, 1964).

REPRESENTATIVE SPECIMENS. **Mexico.** SONORA: 2 mi E of Agua Prieta-Nacozari rd to Oputo & Angostura, 7 Sep 1961, *Turner, Dodge & Mason* 2068 (ARIZ, DS); near Santa Cruz, 1851, *Wright* 1205 (G, GH [3], K, NY, US). UNITED STATES. **Arizona:** COCHISE CO., 10 mi N of Chiricahua Station, 8 Sep 1942, *Barneby* 5135 (NY); Chiricahua Mts, N of Wilgus Ranch, 2 Sep 1907, *Blumer* 2128 (F, GH, NY); Ft Huachuca Military Reservation, 29 Sep 1962, *Goodding* 267-62 (ARIZ); Huachuca Game Preserve, Garden Canyon, 21 Sep 1949, *Goodding* 580-49 (ARIZ [2]); Montezuma Canyon, Huachuca Mts, 17 Oct 1958, *Goodding* 699-58 (ARIZ, UC); Ramsey Canyon, Huachuca Mts, 29 Sep 1929, *Jones* 25045 (NY [2], POM, TEX [2], UC [2]); Huachuca Mts, 3 Sep 1903, *Jones* s.n. (NY, POM); near Apache Pass, Chiricahua Mts, Sep 1881, *Lemmon* 331 (F, UC [2]); Huachuca Mts, Aug 1882, *Lemmon* 2795 (F, G, NY, US); 4½ mi S of Sonoita & Parker Canyon rds, 10 Oct 1965, *Reese* 94 (ARIZ); Bear Canyon, Huachuca Mts, 28 Aug 1936, *Shreve* 7709 (ARIZ); near Ft Huachuca, Aug 1894, *Wilcox* 335 (US); Ft. Huachuca, Aug 1893, *Wilcox* s.n. (NY); PIMA CO., Oak Tree Canyon, Thurber Ranch, Santa Rita Mts, 14 Oct 1940, *Benson* 10598 (ARIZ); Madera Canyon, Santa Rita Mts, 6 Sep 1944, *Clark* 12377 (ARIZ); 17 mi S of Tucson-Benson hwy on rte 83, 21 Oct 1944, *Gould* 2883 (ARIZ); Thurber Ranch, Santa Rita Mts, 14 Sep 1945, *Gould & Haskell* 3268 (ARIZ, DS, GH, NY, UC, US); Santa Rita Mts, 24 Aug 1903, *Jones* s.n. (DS, POM); Madera Canyon, Santa Rita Mts, 24 Aug 1926, *Loomis & King* 2890 (ARIZ); Santa Rita Mts, 16 Sep 1884, *Pringle* 55 (GH, SMU); Greaterville, 16 Sep 1916, *Shreve* 4965 (ARIZ); Empire Ranch, 26 Aug 1936, *Shreve* 7685 (ARIZ, SMU); Santa Rita Mts, Rozemont, 20 Sep 1915, *Thornber* 7404 (ARIZ), 10 Sep 1915, *Thornber* 8121 (ARIZ), 20 Sep 1915, *Thornber* 9050 (ARIZ); SANTA CRUZ CO., Sycamore Creek, ca 23 mi NW of Nogales, 20 Sep 1964, *Cronquist* 10003 (NY); Sycamore Canyon, near Ruby, 30 Sep 1944, *Darrow & Haskell* 2012 (ARIZ, NY, UC, US); near Canoa Tank, Summit Motorway, on

Nogales-Ruby rd, 14 Oct 1944, *Darrow & Haskell* 2256 (ARIZ); Patagonia, 14 Sep 1959, *Goodding* 248-59 (ARIZ); Sonoita Creek, 30-31 Aug [year?], *Harrison* 8181 (F); Nogales, 30 Aug 1931, *Harrison & Fulton* 8153 (ARIZ, US); Sonoita, 2 Sep 1928, *Harrison & Kearney* 5702 (US); Patagonia Mts, 15 Sep 1934, *Kearney & Peebles* 10052 (UC); Sycamore Canyon, SW of Atascosa Mts & SE of Ruby, 3 Oct 1951, *Parker* 7707 (ARIZ, F, RSA, UC, US); Patagonia Mts (Nogales), 28 Aug 1927, *Peebles & Harrison* 4680 (ARIZ, F); Harshaw, 22 Aug 1932, *Shreve* 6003 (ARIZ, F).

13. **Melampodium nayaritense** Stuessy, Brittonia 22:113. *f. 5.* 1970. TYPE: MEXICO: Nayarit, Cañon de Jesús María, 1000 ft, 29 Aug 1905, *P. Goldsmith* 133 (Holotype, NY!; isotypes, F! GH! MO! UC! US!).

Annual herbs, 10-30 cm tall. Stems ascending to erect, 1-2 mm diam, hirtellous with hairs 0.5 mm long. Peduncles 1.5-3.6 cm long. Leaves sessile, linear and entire to deeply pinnately divided, 3-4.5 cm long, 0.2-3.7 cm wide, at apex acute, at base attenuate to obtuse, with upper surface finely strigose with hairs 1 mm long, with lower surface sericeous; margin at base pilose-hispid with hairs up to 1.5 mm long. Heads 5-6 mm tall, 8-11 mm diam. Outer involucre cupulate, 7-10 mm diam; bracts 5, slightly connate at base, separate, obovate-rhombic, 1.5-5.5 mm long, 3-3.5 mm wide, at apex acute-acuminate, with abaxial surface pilose with hairs 1 mm long; margin herbaceous. Fruits 3 mm long, with lateral surfaces ribbed and smooth to markedly tuberculate[10]; hood apex cirrhous, with tapering appendage up to 2 mm long. Ray florets 5-6; ligules yellow, ovate-orbiculate, 2 mm long, 2 mm wide. Disc florets 15-25; corollas yellow, 1.2 mm diam, with throat 0.8 mm and tube 0.6 mm long. Paleae broadly oblanceolate, 3.5 mm long, 1.6 mm wide; apex yellow, with margin entire and undulate; midrib prominent, weakly pubescent with hairs 0.3 mm long. Chromosome number unknown.

Known from woodland hills in northeastern Nayarit, and adjacent Durango, Mexico (Fig. 20), 180-300 m. Flowering dates, Aug-Sep.

[10]In one head of an isotype collection (UC) are found both smooth and roughly tuberculate fruits.

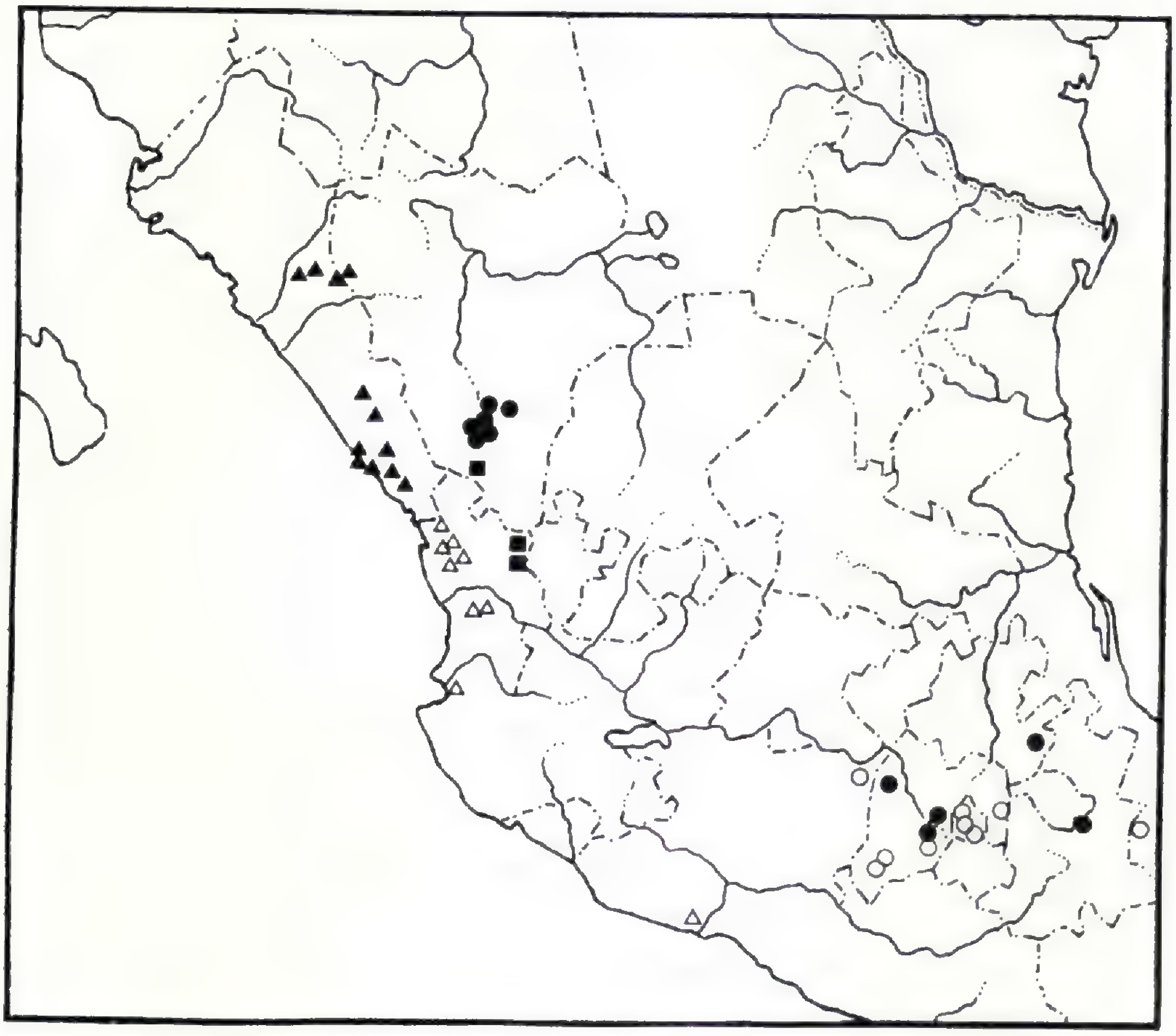

Fig. 20. Map of Mexico showing distribution of *Melampodium bibracteatum* (dots), *M. nayaritense* (squares), *M. repens* (circles), *M. rosei* (closed triangles), and *M. tenellum* (open triangles). One collection of *M. bibracteatum* from Guatemala not shown.

REPRESENTATIVE SPECIMENS. **Mexico.** DURANGO: Huasemota, 14 Aug 1897, *Rose* 3476 (US). NAYARIT: Valley of Río Jesús María, near village of Jesús María, 17 Sep 1960, *Feddema* 1209 (MICH).

4. Series **Cupulata** Stuessy, ser. nov.

Herbae annuae vel perennae (*M. sinuatum*); folia anguste ovata (saepe lobata), subtus strigosa; ligulae luteae vel flavo-aurantiacae, plus quam vel raro circa 2 mm longae; involucrum extimum marginibus scariosis; fructi plerumque cucullati. Species 14-19. Typus: *Melampodium cupulatum* A. Gray.

14. **Melampodium cupulatum** A. Gray, Proc. Amer. Acad. Arts & Sci. 8:291. 1870. TYPE: MEXICO: Sonora, Río Yaqui [27°37′ N, 110°38′ W; McVaugh, 1956], Nov-Dec 1869, *E. Palmer* 20 (Holotype, GH!; isotypes, NY! US[2]!; photograph of US isotype, TEX!).

Eclipta pusilla M. E. Jones, Contrib. West. Bot. 18:70. 1933. TYPE: MEXICO: Baja California, Loreto, Arroyo Undo Ranch, 26 Oct 1930, *M. E. Jones* 27739 (Holotype, POM!).

Annual herbs, 10-35 cm tall. Stems erect, 1-4 mm diam, moderately puberulent to hispidulous with hairs 0.1-0.3 mm long. Peduncles 3.5-8 cm long. Leaves sessile or with short petioles 2-3 mm long, ovate-lanceolate, 3.3-7.5 cm long, 0.8-2.1 cm wide, at apex acute, at base attenuate, with both surfaces strigillose with hairs 0.2-0.3 mm long; margin entire to broadly crenate or sinuate on upper 3/4 of blade. Heads 7-8 mm tall, 9-17 mm diam. Outer involucre cupulate, 6.5-10 mm diam; bracts 5, connate 1/2 their length, ovate to narrowly ovate, 4-6 mm long, 2.7-3.3 mm wide, at apex acute-acuminate, with abaxial surface strigillose with hairs 0.2-0.8 mm long; margin scarious. Fruits 3-3.4 mm long, with lateral surfaces with small tubercles and reticulations.[11] Ray florets 8-12; ligules yellow-orange, oblong-elliptic, 3-6 mm long, 1-3 mm wide. Disc florets 40-60; corollas yellow-orange, 2 mm diam, with throat 0.7 mm and tube 0.3 mm long. Paleae oblanceolate, 3.5 mm long, 1 mm wide; apex yellow, with margin erose; midrib prominent, puberulous with hairs 0.1 mm long. Chromosome number, $n = 10$.

Arid regions of Baja California, Sinaloa, Sonora, and Nayarit, Mexico (Fig. 19), 30-790 m. Flowering dates, Sep-Mar.

REPRESENTATIVE SPECIMENS. **Mexico.** BAJA CALIFORNIA: vicinity of La Cumbre de Alta Gracia, 1 Nov 1964, *Carter* 4880 (DS, UC); Mesa del Potrero de San Javier, 19 Sep 1965, *Carter* 4964 (DS, UC); Cerro Gabilán, S of Portezuelo de Gabilán, 30 Sep 1965, *Carter* 5055 (UC);

[11]Although hoods are usually rudimentary in this species, a few coiled awns on small hoods are found in *Feddema* 1219 from Nayarit.

NE end of Valle de Los Encinos (S side of Cerro Giganta), 28 Sep 1967, *Carter & Moran* 5314 (UC); 2 mi E of Comondú on rd to Loreto, 28 Aug 1955, *Chambers* 965 (DS, UC); N of Comondú, 3 Oct 1941, *Hammerly* 182 (DS, POM); 8 mi S of Querétaro, 29 Nov 1946, *Wiggins* 11507 (DS, GH, UC, US). NAYARIT: near Jesús María, 18 Sep 1960, *Feddema* 1219 (MICH). SINALOA: 5 mi W of Culiacán on rd to Altata, 28 Jan 1964, *Flyr* 112 (TEX); Cerro Tecomate, W of Pericos, 28 Feb 1940, *Gentry* 5750 (ARIZ, DS, GH, NY, UC); Maratón, 12 mi W of Culiacán, 9 Mar 1944, *Gentry* 7005 (DS, F, GH, NY, UC, US); near Culiacán, Oct [year?], *Schaffner* s.n. (GH). SONORA: near rr station, Masiaca, 13 Sep 1930, *Abrams* 12811 (DS); Ciudad Obregón, 29 Sep 1933, *Gentry* 290 (DS); Alamos, 26 Mar-8 Apr 1890, *Palmer* 726 (GH); 4 mi S of La Puerca, SW of Hermosillo toward Tastiota, 4 Sep 1941, *Wiggins & Rollins* 281 (DS, GH, NY, UC, US).

15. **Melampodium appendiculatum** Robins. Proc. Amer. Acad. Arts & Sci. 36:457. 1901. TYPE: MEXICO: Chihuahua, near Frailes [ca 12 km NE of Guachóchic; McVaugh, 1956], ca 7400 ft, Oct 1885, *E. Palmer* 245 (Holotype, GH!; isotype, US!; photograph of US isotype, TEX!).

Melampodium appendiculatum Robins. var. *leiocarpum* Robins. Proc. Amer. Acad. Arts & Sci. 36:457. 1901. TYPE: MEXICO: Sonora, Alamos, 16-30 Sep 1890, *E. Palmer* 726 (not 726, 26 Mar-8 Apr 1890) (Holotype, GH!; isotypes, NY! US!).

Melampodium appendiculatum Robins. var. *sonorense* Robins. Proc. Amer. Acad. Arts & Sci. 36:457. 1901. TYPE: MEXICO: Sonora, Cochuto, 5100 ft, 2 Oct 1890, *C. V. Hartman* 71 (Holotype, GH!).

Annual herbs, 10-40 cm tall. Stems erect, 1-3 mm diam, subglabrous at base to hispid or pilose above with hairs 0.5-1.5 mm long. Peduncles 1-8 cm long. Leaves sessile, linear to lanceolate, 2.5-8.3 cm long, 0.4-1.8 cm wide, at apex acute, at base subauriculate, with both surfaces strigose-hispid with hairs 1-1.5 mm long; margin entire to obsoletely crenate, at base hispid with hairs up to 2 mm long. Heads 5-8 mm tall, 7-17 mm diam. Outer involucre strongly cupulate, 4.5-8 mm diam; bracts 5, connate 2/3 their length, ovate, 3.5-4.5 mm long, 2-3 mm wide, at apex acute, with abaxial surface pubescent-pilose with hairs 0.5

mm long (longer near base); margin scarious. Fruits 2.3-2.8 mm long, with lateral surfaces smooth and glabrous to very tuberculate and striate; hood apex cirrhous (rarely muticous or mucronate)[12], with appendage up to 4 mm long. Ray florets 8-13; ligules yellow-orange, oblong-elliptic, 2-8 mm long, 1-2.9 mm wide. Disc florets 25-40; corollas yellow, 1.3 mm diam, with throat 0.7 mm and tube 0.4 mm long. Paleae oblancolate, 3.2 mm long, 1 mm wide; apex yellow, with margin dentate-laciniate; midrib prominent, puberulent with hairs 0.1 mm long. Chromosome number unknown.

Pine-oak forests in mountains of Sonora, Chihuahua and northwestern Durango, Mexico (Fig. 19), 790-1390 m. Flowering dates, Jul-Nov.

Robinson (1901) described two new varieties within this species based on inner involucral bract differences. From an examination of specimens that indicate intra- and inter-populational variability, however, it seems clear that these described varieties represent simply forms within the morphological range of one species.

REPRESENTATIVE SPECIMENS. **Mexico.** CHIHUAHUA: Guasaremos, Río Mayo, 5 Aug 1935, *Gentry* 1570 (ARIZ, F, GH, NY, UC, US), 3 Aug 1936, *Gentry* 2353 (ARIZ, F, GH); Río Aros, 23 Jul 1937, *LeSueur* 1466 (TEX), 28 Jul 1937, *LeSueur* 1472 (F); Sierra Madre Mts near Seven Star Mine, 27 Aug 1899, *Townsend & Barber* 376 (F, GH, NY, POM, UC, US [2]). DURANGO?: Lodiego [ca 25° N, 106°45′ W; McVaugh, 1956], 9-15 Oct 1891, *Palmer* 1609 in part (F, GH, NY, US). SONORA: 20 mi NE of Ures, 16 Nov 1939, *Drouet, Richards & Lockhart* 3609 (F); Baviácora, W of Río de Sonora, 17 Nov 1939, *Drouet, Richards & Lockhart* 3624 (F); Alamos, Quirocoba, 13 Nov 1933, *Gentry* 790M [790] (ARIZ, DS); San Bernardo, Río Mayo, 14 Jul 1935, *Gentry* 1492 (F, GH); 6 mi S of Nogales, 7 Aug 1965, *R. & J. Matthews* 480 (TEX); San Bernardino Ranch, 22 Aug 1893, *Mearns* 1997 (US); ca 12 mi from Cananea at km 20 on rd to Bacanuchi, 25 Aug 1963, *Moreno* MS-198 (ARIZ); Nácori Chico, Pie de la Cuesta, 6 Oct 1939, *Muller* 3659 (F, UC); Aduana, 10 Aug 1930, *Russell & Souviron* 2 (US); Sta Magdalena, Nov 1855, *Schott* 72 (F, GH, NY),

[12]In the collection *Shreve* 6758 (US), most flowering heads have fruits with long cirrhous appendages, but in one head all the achenes are muticous or only very slightly mucronate.

Schott s.n. (F); 21 mi SE of Moctezuma, 25 Sep 1934, *Shreve* 6758 (ARIZ, US); Arispe, 18 Aug 1958, *Turner* 192 & *Lowe* 2074 (ARIZ); 31 mi S of Nogales along Río de los Alisos, 8 Sep 1934, *Wiggins* 7021 (DS, TEX [2], US); ca 5 mi S of Babiácora along Sonora River, 21 Sep 1934, *Wiggins* 7388 (ARIZ, DS, TEX [2], US); 21 mi S of Moctezuma, 25 Sep 1934, *Wiggins* 7444 (ARIZ, DS, TEX, US); 8 mi S of Nogales & 2 mi W of rr, 3 Oct 1934, *Wiggins* 7533 (DS, US); 8 mi from Matape toward Batuc, 9 Sep 1941, *Wiggins & Rollins* 433 (ARIZ, DS, GH, NY); Puerto de Huépari, NW of Aribabi, 7 Sep 1939, *White* 2784 (ARIZ, GH, US); Cañón de la Gallina, 25 Aug 1940, *White* 3516 (ARIZ, GH); El Rancho de la Nacha, 25 mi W of La Angostura, 14-20 Aug 1941, *White* 3908 (GH); Cañón de la Palomita, N of El Tigre, 29 Aug 1941, *White* 4153 (GH).

16. **Melampodium sinuatum** Brandg. Proc. Calif. Acad. Sci. ser. 2. 3:144. 1891. TYPE: MEXICO: Baja California, San José del Cabo, 16 Sep 1890, *T. S. Brandegee* 302 (not 302, Sep 1891; not 302, 10 Mar 1892) (Lectotype chosen, UC!).

Suffruticose perennials, 8-35 cm tall. Stems erect, 1-2 mm diam, puberulent-canescent with hairs 0.2-0.5 mm long. Peduncles 3-9 cm long. Leaves sessile, linear to elliptic, 2-4.5 cm long, 0.5-1.6 cm wide, at apex obtuse, at base subauriculate, with both surfaces densely strigillose with hairs 0.2-0.3 mm long; margin sinuate-undulate (rarely repand) to irregularly lobed. Heads 6-7 mm tall, 10-20 mm diam. Outer involucre cupulate, 6-9.5 mm diam; bracts 5, connate 3/4 their length, orbiculate, 3-4.5 mm long, 2.5-4.5 mm wide, at apex obtuse, with abaxial surface strigillose-tomentose with hairs 0.4-0.7 mm long; margin slightly scarious. Fruits 2.9-3.2 mm long, with lateral surfaces tuberculate-striate or reticulate. Ray florets 9-13; ligules yellow-orange, elliptic-linear, 4-9 mm long, 1.5-3 mm wide. Disc florets 50-80; corollas yellow-orange, 1.3 mm diam, with throat 1 mm and tube 0.5 mm long. Paleae broadly oblanceolate, 3.5 mm long, 0.8 mm wide; apex yellow, with margin erose-laciniate; midrib prominent, puberulent with hairs 0.1 mm long. Chromosome number unknown.

Low granitic hills near San José del Cabo, Baja California, Mexico (Fig. 19), ca 60 m. Flowering dates, Sep-Mar.

M. sinuatum is one of the three species in the genus, along with *M. cupulatum* and *M. divaricatum* that are found in Baja California. The distributional and morphological similarity of the former two taxa, and the restricted distribution of *M. sinuatum* at the tip of Baja California suggest that this species may have been derived from a mainland ancestral population of *M. cupulatum.*

REPRESENTATIVE SPECIMENS. **Mexico.** BAJA CALIFORNIA: San José del Cabo, Sep 1891, *Brandegee* 302 (GH, US); Sierra de la Trinidad, Nov 1902, *Brandegee* s.n. (UC [2], US); 12.2 km SW José del Cabo, 16 Dec 1947, *Carter, Alexander & Kellogg* 2216 (DS, UC, US); San José del Cabo, Mar 1901, *Purpus* 416 (UC, US); 5 mi W of San José del Cabo, 17 Dec 1958, *Wiggins* 14377 (DS, GH, TEX, UC).

17. **Melampodium rosei** Robins. Proc. Amer. Acad. Arts & Sci. 36:461. 1901. TYPE: MEXICO: Sinaloa, between Rosario & Concepción, 28 Jul 1897, *J. N. Rose* 3271 (Holotype, US!; photograph of holotype, TEX!).

Melampodium arenicola Robins. Proc. Amer. Acad. Arts & Sci. 36:457. 1901. TYPE: MEXICO: Sinaloa, Mazatlán, Isla Piedra, 31 Dec 1894, *F. H. Lamb* 361a (Holotype, GH!; isotypes, G[2]! MO! NY! US!; photograph of US isotype, TEX!).

Melampodium rosei Robins. var. *subintegrum* Robins. Proc. Amer. Acad. Arts & Sci. 36:462. 1901. TYPE: MEXICO: Sinaloa, Rosario, 7 Jul 1897, *J. N. Rose* 1568 (Holotype, US!; isotypes, F! GH!; photograph of holotype, TEX!; photograph of K isotype, US!).

Annual herbs, 10-50 cm tall. Stems erect to decumbent, 1-3 mm diam, glabrous near base to hispidulous above with hairs up to 0.5 mm long. Peduncles 2-5 cm long. Leaves sessile, lanceolate to oblong-ovate, 3-5.5 cm long, 0.5-2 cm wide, at apex obtuse to acute, at base subauriculate (rarely obtuse), with both surfaces strigose with hairs 0.3-1 mm long; margin subentire to strongly lobed. Heads 4-6 mm tall, 7-12 mm diam. Outer involucre cupulate, 5-8 mm diam; bracts 5, connate 1/4 or less their length at base, separate to imbricate 3/4 their length, orbiculate to ovate, 2.5-3.8 mm long, 1.5-3.5 mm wide, at apex broadly rounded to acute, with abaxial surface subglabrous to strigillose

with hairs 0.3 mm long (longer near base); margin scarious. Fruits 1.1-2.3 mm long, with lateral surfaces smooth to striate (sometimes very tuberculate); hood apex muticous or less often mucronate to cirrhous, with appendage up to 3 mm long. Ray florets 8-9; ligules yellow-orange, oblong-elliptic, 3-6 mm long, 1-2.3 mm wide. Disc florets 40-60; corollas yellow-orange, 1.6 mm diam, with throat 0.7 mm and tube 0.5 mm long. Paleae broadly oblanceolate, 2.7 mm long, 0.8 mm wide; apex yellow, with margin laciniate; midrib prominent, weakly puberulent with hairs 0.2 mm long. Chromosome number, $n = 10$.

Tropical deciduous and thorn forests in Sinaloa and adjacent Durango, Mexico (Fig. 20), 0-400 m. Flowering dates, Aug-Jan.

Some of the specimens on Isla Piedra off the coast of Mazatlán (type locality of *M. arenicola*) possess more lobed leaves, a tendency toward decumbent stems, larger heads, and narrower and longer ligules than is typical for the species. Because these forms exhibit considerable character intergradations and are found also intermixed in at least one population on the mainland (personal observations), they are not here formally recognized. With *M. arenicola* and *M. rosei* regarded as being conspecific and because both names were published at the same time, one of the epithets must be selected for use. *M. rosei* has been chosen because this name has been applied almost exclusively in identifications of previous collections of this taxon.

Collections from Ymala (Imala), Sinaloa, at the northwest portion of the range of this species morphologically approach *M. cupulatum*, a species found nearby (Fig. 19). Hybridization between the two taxa cannot be exluded.

REPRESENTATIVE SPECIMENS. Mexico. DURANGO: La Bajada, Tamazula, Nov 1921, *Ortega* 4446 (US). SINALOA: Mazatlán, 3 Nov 1893, *Brandegee* s.n. (US); 2 mi SE of Mazatlán, 4 Aug 1938, *Eyerdam & Beetle* 8687 (ARIZ, UC); Mazatlán, 15 Sep 1927, *Ferris* 5020 (DS); vicinity of Labradas, 18 Sep 1925, *Ferris & Mexia* 5078 (DS, GH); near Mazatlán, 29 Jan 1964, *Flyr* 138 (TEX); ca 2 mi N of Escuinapa, 13 Aug 1960, *King* 3707 (DS, NY, TEX, UC, US); ca 12 mi N of Escuinapa, 13 Aug 1960, *King* 3709 (DS, NY, RSA, TEX, UC); ca 13 mi N

of Rosario, 13 Aug 1960, *King* 3710 (DS, NY, TEX, UC, US); ca 21 mi N of Rosario, 13 Aug 1960, *King* 3712 (DS, NY, TEX, UC, US); ca 3 mi S of Mazatlán, 13 Aug 1960, *King* 3715 (DS, NY, TEX, UC, US); ca 10 mi NE of jct rtes 15 & 40, 14 Aug 1960, *King* 3716 (DS, NY, TEX, UC); Mazatlán, on Isla Piedra, 31 Dec 1894, *Lamb* s.n. (DS, UC, US); Mazatlán, 2 Jan 1895, *Lamb* s.n. (DS, GH, NY, UC, US); San Agustín, 1921, *Ortega* 4008 (US); Escuinapa, 1926, *Ortega* 6125 (US), 1933, *Ortega* 7004 (F); Ymala [Imala], [25°42′ N, 107°15′ W; McVaugh, 1956], 16-25 Aug 1891, *Palmer* 1457 (F, GH, US), 25 Sep-8 Oct 1891, *Palmer* 1757a (ARIZ, GH, US); 10 mi E of jct rtes 15 & 40, 26 Aug 1961, *Powell & Edmondson* 908 (TEX); near Colomas, 19 Jul 1897, *Rose* s.n. (US); between Mazatlán & Villa Unión, 14 Dec 1936, *Shreve* 7821 (ARIZ, F); 4.5 mi N of Escuinapa, 4 Sep 1965, *Stuessy* 404 (TEX); Isla Piedra, Mazatlán, 28 Aug 1966, *Stuessy* 748 (TEX); 4 mi S of Mazatlán, 28 Aug 1966, *Stuessy* 750 (TEX); 12-15 km SE of Mazatlán, 4 Aug 1938, *Worth & Morrison* 8807 (UC, US); Mazatlán & vicinity, Dec 1888, *Wright* 1213 (DS, F, UC, US).

18. **Melampodium tenellum** Hook. & Arn. Bot. Beech. Voy. 299. 1838. TYPE: MEXICO: Nayarit, Tepic, 1825-28, *G. T. Lay & A. Collie et al.* s.n. (Holotype, K!; photograph of holotype, F! MICH! OS! TEX! US!; photograph and fragment of holotype, US!).

Annual herbs, 6-30 cm tall. Stems erect (rarely decumbent), 1-2 mm diam, subglabrous to hispidulous with hairs 0.3 mm long. Peduncles 3-7 cm long. Leaves sessile or with petioles 2-10 mm long, lanceolate to narrowly ovate, 2-5.5 cm long, 0.5-1.4 cm wide, at apex obtuse (less often acute), at base attenuate (rarely obtuse), with both surfaces scatteredly strigose with hairs 0.3 mm long; margin subentire to shallowly lobed. Heads 3.5-5.5 mm tall, 6-14 mm diam. Outer involucre cupulate, 3.5-7 mm diam; bracts 5, connate 1/4-1/2 their length, separate to imbricate, orbiculate to ovate, 2.5-3.5 mm long, 2.5-3 mm wide, at apex acute to rounded, with abaxial surface strigillose-hispidulous with hairs 0.3 mm long; margin scarious. Fruits 1.8-2.6 mm long, with lateral surfaces usually with 4 longitudinal rows of tubercles (rarely smooth); hood apex muticous. Ray florets 8-9; ligules yellow-orange, oblong-elliptic, 2-5 mm long, 1-2.8 mm wide. Disc florets 40-60; corollas yellow-orange, 1.3 mm diam, with throat 0.8 mm and tube 0.5 mm

long. Paleae oblanceolate, 2.5 mm long, 0.7 mm wide; apex yellow, with margin laciniate; midrib prominent, glabrous. Chromosome number, $n = 10$.

Tropical deciduous forests and savannas in Nayarit, Jalisco, and Michoacán, Mexico (Fig. 20), 30-920 m. Flowering dates, Jul-Nov.

M. tenellum is morphologically similar to *M. rosei*, but each species does possess unique morphological and geographic features. As in *M. rosei*, however, *M. tenellum* also has considerable variation in vegetative and outer phyllary morphology. Much additional work will be needed before this intraspecific variation can be understood satisfactorily.

REPRESENTATIVE SPECIMENS. Mexico. JALISCO: Puerto Vallarta, 20 Jul 1932, *Howell* 10303 (US). MICHOACÁN: 24 km S of Arteaga, 29 Nov 1968, *Rzedowski* 26618 (OS). NAYARIT: E of Tepic along Río Tepic, 22-24 Aug 1935, *Pennell* s.n. (GH); Santiago Ixc., Mezcaltitán, Jan 1926, *González* 6125 (DS, US); ca 38 mi S of Nayarit-Sinaloa border on rte 15, 12 Aug 1960, *King* 3703 (DS, NY, TEX, UC, US); ca 28 mi S of Nayarit-Sinaloa border on rte 15, 12 Aug 1960, *King* 3704 (DS, NY, RSA, TEX, UC); ca 21 mi S of Nayarit-Sinaloa border on rte 15, 13 Aug 1960, *King* 3705 (DS, NY, TEX, UC, US); ca 1 mi S of Nayarit-Sinaloa border on rte 15, 13 Aug 1960, *King* 3706 (DS, NY, RSA, TEX, UC); 27.9 mi SE of Nayarit-Sinaloa border on rte 15, 4 Sep 1965, *Stuessy* 401 (TEX); 10 mi NW of jct rte 15 & rd to Tuxpán, 27 Aug 1966, *Stuessy* 745 (TEX).

19. **Melampodium glabribracteatum** Stuessy, Brittonia **22**: 112. *f. 3.* 1970. TYPE: MEXICO: Oaxaca, Cerro de San Antonio, Ocotlán, 1600 m, 29 Aug 1936, *C. Conzatti* 5169 (Holotype, K!; photograph of holotype, OS! TEX!).

Annual herbs, 15-22 cm tall. Stems erect to decumbent, 1-1.5 mm diam, subglabrous at base to pilose above with hairs up to 1 mm long. Peduncles 1.3-1.7 cm long. Leaves sessile, blades lanceolate, 2-3.3 cm long, 0.4-0.7 cm wide, at apex obtuse, at base obtuse-subauriculate, with both surfaces sparingly strigose with hairs up to 1 mm long; margin entire or rarely 2-lobed, near base pilose with hairs up to 1 mm long. Heads 5-6 mm tall, 6-9 mm diam. Outer involucre cupulate, 7-8 mm diam; bracts 5, slightly connate

at base, imbricate 3/4 their length, elliptic-orbiculate, 3-4 mm long, 2.4-3.2 mm wide, at apex rounded, with abaxial surface glabrous; margin narrowly scarious, ciliate with hairs up to 0.6 mm long. Fruits 2.1-2.5 mm long, with lateral surfaces ribbed and tuberculate-aculeate; hood apex cirrhous, with tapering appendage up to 2 mm long. Ray florets 6-8; ligules yellow, ovate-oblong, 3.5 mm long, 2-2.5 mm wide. Disc florets ca 30; corollas yellow, 1 mm diam, with throat 1 mm and tube 0.7 mm long. Paleae oblanceolate, 3.3 mm long, 0.8 mm wide; apex yellow, with margin smooth-erose; midrib prominent, glabrous. Chromosome number unknown.

Known only from the type collection from pine-oak forests near Ocotlán, Oaxaca (Fig. 11), 1600 m. Flowering date, Aug.

5. Series **Longipila** Stuessy, ser. nov.

Herbae annuae; folia late ovata, subtus sericea; ligulae flavae-aurantiacae, plus quam 2 mm longae; involucrum extimum marginibus herbaceis; fructi apice arista adaxiali complanato cirrhoso. Species 20. Typus: *Melampodium longipilum* Robins.

20. **Melampodium longipilum** Robins. Proc. Amer. Acad. Arts & Sci. 27:173. 1892. TYPE: MEXICO: San Luis Potosí, San José Pass, 11 Jul 1890, *C. G. Pringle* 3639 (Holotype, GH!).

Melampodium villicaule Greenm. Field Col. Mus. Pub. Bot. 2:345. 1912. TYPE: MEXICO: Guerrero, Río Balsas, 26 Aug 1910, *C. R. Orcutt* 4386 (Holotype, F!).

Annual herbs, 7-30 cm tall. Stems erect, 0.7-4 mm diam, villous with hairs 2 mm long. Peduncles 2-11.5 cm long. Leaves with short and broad petioles (rarely sessile) 3-6 mm long, with blades ovate to elliptic, 2-7.5 cm long, 0.5-3 cm wide, at apex acute, at base attenuate to partially subauriculate, with both surfaces pilose with hairs 1 mm long; margin entire. Heads 5-7.5 mm tall, 7-12 mm diam. Outer involucre markedly cupulate, 6.5-9.5 mm diam; bracts 5,

slightly connate at base, imbricate 1/2 their length, ovate, 3.5-5 mm long, 2-3.5 mm wide, at apex acute, with abaxial surface pilose with hairs 1 mm long; margin herbaceous. Fruits 2.2-2.8 mm long, with lateral surfaces tuberculate or striate with tapering cirrhous appendages up to 8 mm long. Ray florets 7-8; ligules yellow-orange, ovate-elliptic, 3.5-5.5 mm long, 1.8-4 mm wide. Disc florets 40-70; corollas yellow-orange, 1.2 mm diam, with throat 0.8 mm and tube 0.5 mm long. Paleae oblanceolate, 3.5 mm long, 0.8 mm wide; apex yellow, with margin laciniate-dentate; midrib prominent, pubescent with hairs 0.5 mm long. Chromosome number, $n = 10$.[13]

Scattered in tropical deciduous and pine-oak forests of western Guatemala and the Mexican states of San Luis Potosí, Hidalgo, Puebla, Guerrero, and Oaxaca (Fig. 12), 1370-3050 m. Flowering dates, Jul-Nov.

In my opinion this species is morphologically closest to *M. tenellum,* although Turner and King (1962) have suggested that its relationship is with *M. divaricatum* (in section *Serratura*). The unusual adaxially flattened appendage (Fig. 8) makes *M. longipilum* unique within the genus, and this feature along with other characters such as large ovate leaves and markedly cupulate outer involucres suggests separation of the species as a monotypic series. Considered somewhat rare before the present treatment, *M. longipilum* is quite common especially throughout Oaxaca.

REPRESENTATIVE SPECIMENS. **Guatemala.** HUEHUETENANGO: Cumbre Papal between Cuilco & Ixmoquí, 19 Aug 1942, *Steyermark* 50916 (F, NY). **Mexico.** GUERRERO: 19 mi N of Chilpancingo, 29 Aug 1965, *Stuessy* 374 (TEX). HIDALGO: Metztitlán, SE of Metztitlán, 24 Nov 1942, *Moore* 2283 (GH). OAXACA: ca 64 mi SE of Oaxaca, 23 Jul 1960, *King* 3461 (DS, NY, TEX, UC, US); 13 mi NW of Tehuantepec, 23 Aug 1965, *Stuessy* 328 (TEX); 3.8 mi NW of Huajuapán de León, 25 Aug 1965, *Stuessy* 344 (TEX); 10 mi NW of Tehuantepec, 11 Aug 1966, *Stuessy* 634 (OS, TEX); 51 mi NW of Tehuantepec, 11 Aug 1966, *Stuessy* 636 (TEX); 87 mi NW of Tehuantepec, 11 Aug 1966, *Stuessy* 637 (TEX); 28 mi S of Zimatlán, 12 Aug 1966, *Stuessy* 639 (TEX). PUEBLA: Tehuacán, Sep 1911, *Purpus* 5619 (GH, NY, UC); near

[13]See Stuessy (1971b) for a discussion of the $n = 11$ count for this species.

Tehuacán, 30 Aug-8 Sep 1905, *J. N. & J. S. Rose & Painter* 10137 (US); Asunción de Chila, 25 Aug 1965, *Stuessy* 346 (TEX); 32 mi NW of Huajuapán de León, 25 Aug 1965, *Stuessy* 347 (TEX); 2 mi NW of Tehuitzingo, 16 Aug 1966, *Stuessy* 667 (TEX). SAN LUIS POTOSÍ: Villar, 14 Sep 1893, *Pringle* 4537 (F, G, NY, UC, US [2]).

(To be continued)

IN MEMORIAM

CHARLES SCHWEINFURTH, 1890-1970

November 16, 1970 marks the end of an outstanding era in the annals of American orchidology.

Charles Schweinfurth was born on April 13, 1890 in Brookline, Massachusetts, in one of the oldest and most

historic regions of the United States. During his formative years he attended public schools in Brookline where he quickly developed an intense devotion to various aspects of natural history. While his interest in bird watching and plant collecting started as an avocation, they became the driving force for his whole life soon after graduation from college.

He entered Harvard University in 1909 and majored in chemistry, graduating in 1913 with a degree of A.B., *cum laude*. This was a remarkable achievement, for in his sophomore year he succumbed to polio which paralyzed his right arm. To regain the use of his arm, with a self discipline that characterized his whole life, he soon started daily exercises, aided by his devoted parents. He maintained this discipline almost to his last days. When he was informed by his doctors that he must abandon chemistry, he found a life-long career in his avocation.

Charles' commitment to botany became officially registered on April 5, 1912 when he was elected a member of the New England Botanical Club. He faithfully supported, as well as promoted, its interest, often beyond the call of duty. It was, indeed, a rare occurrence when Charles would succumb to some more compelling business than the attendance of the club's monthly meetings. It was in this same spirit that he accepted the burdensome responsibility of corresponding secretary in 1949, a post he held in the club until 1965, when he had to resign from it due to his doctor's order. His memberships included, among others, also the American Association for the Advancement of Science, the International Association for Plant Taxonomy, the National Audubon Society, the Appalachian Mountain Club, and the Boston Museum of Science.

Charles had many avocations in addition to his ardent bird watching. During the summer months he enjoyed traveling, since he was greatly interested in the classical aspects of our cultural past. Consequently photography became a second nature to him in recording precious impressions, especially of paintings, sculptures and architec-

tural designs for his leisure viewing at home or for sharing them with others at some later time. During winter months he spent much of his extra-curricular time on writing for local newspapers, as well as in pursuit of winter sports, notably ice skating.

The professional life for Charles Schweinfurth started in 1914 when he accepted a position offered to him by Professor Oakes Ames to tend the living orchid collection at North Easton, Massachusetts. Within less than a year Professor Ames, recognizing Charles' great ability for remembering scientific names and fine details, took him on as a personal assistant to work in his private "Ames Botanical Laboratory", also in North Easton.

It was then that his orchidaceous career started. From January, 1915, Charles Schweinfurth was an orchidologist. He worked intensively on the orchids of the Philippines, those from Mt. Kinabalu, British North Borneo and various Pacific islands, followed by studies of the orchids of Honduras, Costa Rica and Panama. In 1936, he co-authored with Ames and Hubbard an extensive monographic study, "The Genus Epidendrum in the United States and Middle America".

These works alone would suffice to record him among outstanding orchidologists. Charles, however, has built an even more imposing monument for posterity. True to his good nature and encouraged by Professor Ames, in 1922 he accepted an offer made by J. Francis Macbride to write up the orchid family for his proposed "Flora of Peru". He labored year after year and on April 9, 1958, the first of the four parts of his monumental work appeared in publication. This work was the first descriptive treatise on orchids of any Andean country.

Charles, like many of the outstanding botanists, while working on a given project, concurrently undertook others. He accepted the very onerous task of identifying the numerous colored plates prepared under the supervision of Celestino Mutis during La Real Expedición Botánica del Nuevo Reino de Granada, between 1760 and 1817. The first

volume of this labor of love was published in 1963, while the second volume appeared in 1969.

In 1958, Charles attended the 3rd South American Botanical Congress in Lima, Peru, where he was awarded Catedratico Honorario (Honorary Professor of Botany) by Universidad Mayor de San Marcos, the oldest university of the Americas. It was during that year, when he also visited Colombia, that the picture reproduced here was taken by his colleague, Dr. Hernando Garcia-Barriga of Universidad Nacional, Bogota, during a visit to the Paramo de Chipaque.

Charles received another award of Catedratico Honorario in 1962, from Universidad de Cuzco. In 1964, he was honored by the American Orchid Society with a Gold Medal inscribed "For outstanding contributions to orchidology", and on July 12, 1966, he was elected Miembro Honorario by Sociedad Colombiana de Orquideologia.

On November 29, 1965, the staff of the Botanical Museum of Harvard University honored him on the occasion of his Golden Jubilee in Orchidology with a scroll, inscribed as follows: "Fifty years have passed since our colleague Charles Schweinfurth initiated his productive career in orchidology. Dean of the world's orchidologists, like his predecessors Lindley, Rolfe, Reichenbach, Schlechter, Kraenzlin, Smith and Ames, he has made invaluable contributions to our knowledge of the systematics of the orchids of both the Old and the New World. His great number of publications, his elucidation of the intricate structure of orchid flowers, his augmentation to our knowledge of the phytogeography of orchids, his acute powers of observation for minute details, his loyalty and his dedication to his chosen field stand as an inspiration to both present and future students of orchidology. In grateful recognition of these fifty years of service to orchidology, we of the Botanical Museum of Harvard University present this scroll."

The most meaningful event in Charles' life, however, occurred in December 1963, when, after a visit to the Holy Land, he married the lifelong friend of the Schweinfurth

family, Miss Maria Elizabeth Westergren of Stockholm, Sweden. The blessings of this mature companionship he openly cherished throughout the rest of his life.

The orchid world is vastly richer today for there was a Charles Schweinfurth intimately associated with it. And for those few who had the privilege of sharing his meaningful friendship, not only the orchid world, but the whole world was just a little better to live in.

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NOMENCLATURAL CHANGES IN LESQUERELLA

REED C. ROLLINS AND ELIZABETH A. SHAW

During the last twenty years there has been a gradual introduction into the International Code of Botanical Nomenclature of provisions for the automatic recognition of tautonymous names and epithets when a taxon in a category of infrafamilial rank (other than genus or species) is segregated from one of the next higher rank. In the Code adopted at Stockholm (Reg. Veg. 3: Arts. 34, 35. 1952) it was clearly stated that valid publication of the name of a taxon of infraspecific rank which does not include the type of the name of the taxon of the next higher rank automatically establishes in parallel the name of a second taxon of the same subordinate rank, this having the same type as does the name of the taxon of higher rank and the same epithet. At Paris similar provisions were made for categories of infrageneric rank (Reg. Veg. 8: Art. 22. 1956) and at Montreal for categories of infrafamilial rank (Reg. Veg. 23: Art. 19. 1961). However it soon became apparent that the very broad application of this useful principle to the name of any taxon which includes the nomenclatural type of the name of the taxon next higher in rank can give rise to complications.

Although the International Code of Botanical Nomenclature (Reg. Veg. 46: Arts. 2, 3. 1966) makes it clear that every Recent plant belongs to a species, a genus, and a family (as well as to an order, a class, and a division) it nowhere provides that a plant must belong to a subspecies or to a section, a series, or to a tribe. The use of such categories of intermediate, and optional, rank reflects only a recognition of the possibility of using more hierarchical steps within the framework of the required classification. The sweeping extension of the principle of automatic recognition of tautonyms to names of taxa in such optional ranks creates the possibility that a taxon with a particular circumscription, position and rank might have, according

to the classification used, two correct names. Classification and nomenclature are thus entangled in a way contrary to Principle IV of the Code. Such distressing situations were discussed by Wood & Webster (1968) and a series of carefully worded proposals intended to clarify matters was submitted to, and accepted by, the 11th International Botanical Congress in 1969. In essence, these modifications restrict the automatic recognition of tautonyms in the optional ranks to names of only those taxa which *do include* the type of the name of a species, a genus, or of a family. In the other optional ranks, strict priority of publication applies.

Difficulties arising from the entanglement of classification and nomenclature have come to light more often in dealing with categories ranked between family and genus, or between genus and species, than with those below the rank of species, and Wood & Webster were not entirely satisfied with the example used with their proposal for modification of Article 26, which deals with names of taxa of infraspecific rank, in the then current edition of the Code. In the course of our revision of the North American species of *Lesquerella* (in press), we made certain decisions resulting in our recognition of two subspecies of *Lesquerella lasiocarpa* (Hook. ex Gray) Watson, and, in that subspecies *not* including the type of the name of the species, of two varieties. We realized that one taxonomic decision in particular had produced precisely the situation Wood & Webster had in mind when proposing the change in Article 26. Since this is being used as an example in the forthcoming edition of the Code, we wish to make the necessary nomenclatural changes here and to provide some explanation of them. Our classification of *L. lasiocarpa* is summarized as follows:

(1) **Lesquerella lasiocarpa** subsp. **lasiocarpa**
Vesicaria lasiocarpa Hook. ex Gray, Smithson. Contrib. Knowl. 5: 13. 1853. Type: Texas. between Bexar & Trinity River, *Berlandier* in 1828 (K)

(2) **Lesquerella lasiocarpa** subsp. **berlandieri** (Gray) Rollins & Shaw, comb. nov.

Synthlipsis berlandieri Gray, Bot. Mex. Bound. Survey 34. 1859. Lectotype (here designated): Mexico. Tamaulipas, Matamoros, *Berlandier* 3017 (GH), isotypes (MO, US)

(2a) **L. lasiocarpa** [subsp. **berlandieri**] var. **hispida** (Wats.) Rollins & Shaw, comb. nov.

Synthlipsis berlandieri var. *hispida* Wats., Proc. Amer. Acad. **17**: 321. 1882. Holotype: locality uncertain, *Palmer* 26 (GH)

S. berlandieri Gray (see above)

L. lasiocarpa var. *berlandieri* (Gray) Payson, Ann. Missouri Bot. Gard. **8**: 139. 1922

L. lasiocarpa var. *ampla* Rollins, Rhodora **57**: 245. 1955. Holotype: Mexico. Tamaulipas, vicinity of Victoria, *Palmer* 41 (GH), isotype (NY)

(2b) **L. lasiocarpa** [subsp. **berlandieri**] var. **heterochroma** (Wats.) Rollins, Rhodora **57**: 245. 1955

Synthlipsis heterochroma Wats., Proc. Amer. Acad. **17**: 321. 1882

According to the provisions of the 1966 edition of the Code, it would have been necessary to use the name *L. lasiocarpa* [subsp. *berlandieri*] var. *berlandieri* [without an author — not "(Gray) Payson"] for that variety (2a) of subsp. *berlandieri* which includes the type of the name of the subspecies, no matter how it might be circumscribed, when recognizing taxonomically, as we do, this optional category. Still following the 1966 edition of the Code, if one chose not to adopt the category "subspecies" in classifying the infraspecific taxa of *Lesquerella lasiocarpa*, but used only "varietas," the correct name for this taxon, still with the same circumscription, position, and rank, would be *L. lasiocarpa* var. *hispida* (Wats.) Rollins & Shaw. This is the earliest available epithet in the rank of variety for a taxon which does not include the type of the name of the taxon of next higher rank. Thus, depending upon the classi-

fication used (whether subspecies or not in the present instance), this one variety could have two correct names, a situation contrary to Principle IV.

The crux of the matter is our decision to circumscribe the variety which includes the type of the name *L. lasiocarpa* subsp. *berlandieri* so as to include *Synthlipsis berlandieri* var. *hispida* Watson. Article 26 as modified at Seattle now provides that use of a tautonymous epithet without citation of an author's name applies only to the names of taxa of infraspecific rank which do include the type of the name of the species to which they are assigned. Since variety 2a does not include the type of the name *L. lasiocarpa*, the earliest available epithet in varietal rank, if one such exists, must then be used for it, and in this case it is "hispida". In Payson's classification, based upon different criteria, *S. berlandieri* var. *hispida* was not placed in the synonymy of *S. berlandieri*, and he was thus quite correct in his use of the name *L. lasiocarpa* var. *berlandieri* (Gray) Payson. However, according to the Code as modified at Seattle, the taxon, as circumscribed by us, is to be called *Lesquerella lasiocarpa* var. *hispida* (Wats.) Rollins & Shaw.

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GRAY HERBARIUM OF HARVARD UNIVERSITY
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THE PARKER CLEAVELAND HERBARIUM OF BOWDOIN COLLEGE

EDWARD HEHRE, A. R. HODGDON, AND R. B. PIKE[1]

The Herbarium of Bowdoin College, Brunswick, Maine, which was assembled in the 19th century under the direction of Parker Cleaveland (1780-1858) was stored away in the attic of Searle's Science Building at Bowdoin College for over half a century. Professor Cleaveland was a distinguished naturalist in the nineteenth century tradition. He is best known for the collection of minerals housed for many years in the "Cleaveland Cabinet" in Massachusetts Hall at Bowdoin College. Cleaveland had studied under Goethe who recommended him highly when he began his career in Brunswick in 1805. That he had much knowledge of botany and of botanists is suggested by the important collections that came his way. However, the Cleaveland Collection, like many herbaria in small colleges, ceased to grow and became isolated and inaccessible after its auspicious beginning, and because of neglect, failed to fulfill the purpose for which it had been assembled.

Through the kindness of the President and overseers of Bowdoin College, the Cleaveland Herbarium is now on a ten-year loan to the University of New Hampshire.

By means of support provided by Mr. Sumner Pike of Lubec, Maine, the collection of approximately 9,400 specimens was given a thorough and painstaking rehabilitation by the senior author. Most specimens were in good condition with a minimum of damage by mold and insects but nearly all required remounting and, for a great many, some nomenclatural updating. The entire collection now is incorporated in the University of New Hampshire Herbarium (NHA), each sheet being stamped with the Bowdoin Seal for ready recognition.

[1]Published with the approval of the Director of the New Hampshire Agricultural Experiment Station as scientific contribution number 610.

For a relatively small collection, the Cleaveland Herbarium is notable for its representation of important collectors. One can speculate that Professor Cleaveland intended at the beginning to create an important botanical center at Bowdoin.

The first two successful collectors who worked for Gray in the 1840s are represented with 124 specimens by Ferdinand Lindheimer (1801-1879) and 207 from New Mexico by Augustus Fendler (1813-1883) of which 39 are isotypes of species described by Gray and others. There are even duplicate isotypes for 13 of the taxa. Dupree (1959) briefly and McKelvey (1955) at much greater length discuss the activities of these two botanical collectors of the American Southwest.

There follows a partial and by no means complete list of other botanists whose collections are to be found in the Cleaveland Herbarium:

Michael S. Bebb (1833-1895) — 157 specimens, preponderantly from Illinois.

Joseph Blake (1814-1888) — nearly 1500, chiefly from Cumberland County in Maine and some in Cöos, Carroll, Grafton and Belknap Counties in New Hampshire.

William Boott (1805-1887) — 16 from the White Mountains of New Hampshire.

William N. Canby (1831-1904) — 256 from Delaware and adjoining areas.

Parker Cleaveland (1780-1858) — about 500, mostly from Brunswick, Maine.

Chester Dewey (1784-1867) — 4 of Carex.

Asa Gray (1810-1888) — 16 (*ex herbario* W. S. Poor)

John S. Henslow (1796-1861) — father-in-law of Joseph Dalton Hooker and whose recommendation led to Darwin's accepting the post of naturalist on the "Beagle" — 271 from Great Britain.

Marcus E. Jones (1852-1934) — 66 collected about 1880 in Rocky Mountain area.

Peter D. Knieskern, M.D. (1798-1871) — 119 from New Jersey.

William Oakes (1799-1848) — 52 from Massachusetts and New Hampshire, without date.
Thomas C. Porter (1822-1901) — 129 from Pennsylvania.
Henry P. Sartwell (1792-1867) — 114 from western New York State, 87 of these being *Carex*.
Frank Lamson Scribner (1851-1938) — the first U.S.D.A. Plant Pathologist — 140 from Manchester, Maine.
Edward Tuckerman, Jr. (1817-1886) — 250 mostly from New England, a few from central Europe.
George Vasey (1822-1893) — 160 from Illinois.
Oliver R. Willis (1815-1902) — 335 from New Jersey.

Nearly all the specimens of any particular collector are of different species and since many of the collectors were specialists on certain groups and worked in different parts of the world, the collection contains a very great number of species.

The Herbarium of the University of New Hampshire (NHA) is now being computerized and it will soon be possible to provide interested persons with considerable information as to the collectors represented as well as information on the labels of the plants they collected. For the Parker Cleaveland collection, in the case of each important collector, we have made lists of all species represented. Thus we are in a position now to supply this information.

Wooton & Standley (1915) give type localities for all taxa and often specify the collectors. For Fendler, usually the collection number is cited making it comparatively easy to locate his isotypes. A large percentage of Fendler's isotypes of New Mexican plants is represented in the Cleaveland collection.

List of Fendler isotypes in the Parker Cleaveland Herbarium:

1. *Selaginella Underwoodii* Hieron., (in duplicate), *Fendler* 1024.
2. *Cheilanthes Fendleri* Hook., *Fendler* 1015.
3. *Poa Fendleriana* (Steud.) Vasey, (in duplicate), *Fendler* 932.

4. *P. Bigelovii* Vasey & Scribn., *Fendler* 931.
5. *Aristida Fendleriana* Steud., *Fendler* 973.
6. *A. longiseta* Steud., (in duplicate), *Fendler* 978.
7. *Cyperus Fendlerianus* Boeckel, *Fendler* 865.
8. *Salix Fendleriana* Anderss., *Fendler* 816.
9. *S. irrorata* Anderss., *Fendler* 812.
10. *Quercus novemexicana* (A.DC) Rydb., *Fendler* 809.
11. *Arceuthobium cryptopodium* Engelm., *Fendler* 283.
12. *Phoradendron juniperinum* Engelm., *Fendler* 281.
13. *Abronia Fendleri* Standley, *Fendler* 739.
14. *Lesquerella intermedia* (S. Wats.) Heller, (in duplicate), *Fendler* 38.
15. *Draba neomexicana* Greene, (in duplicate), *Fendler* 43.
16. *Arabis Fendleri* (S. Wats). Greene, *Fendler* 27.
17. *Potentilla propinqua* Rydb., *Fendler* 198.
18. *Astragalus ceramicus* Sheld., (in duplicate), *Fendler* 161.
19. *A. lonchocarpus* Torr., *Fendler* 160.
20. *Euphorbia Fendleri* Torr. & Gray, (in duplicate), *Fendler* 800.
21. *Sphaeralcea Fendleri* A. Gray, *Fendler* 78.
22. *Galpinsia Fendleri* (A. Gray) Heller, *Fendler* 230.
23. *Cymopterus Fendleri* A. Gray, *Fendler* 274.
24. *Daphnidostylis Fendleriana* Klotzsch, *Fendler*.
25. *Dodecatheon radicatum* Greene, *Fendler* 549.
26. *Mertensia Fendleri* A. Gray, *Fendler* 625.
27. *Oreocarya fulvocanescens* (S. Wats.) Greene, (in duplicate), *Fendler* 632.
28. *Oreocarya multicaulis* (Torr.) Greene, *Fendler* 636.
29. *Hydrophyllum Fendleri* (A. Gray) Heller, *Fendler* 642.
30. *Lycium pallidum* Miers., *Fendler* 670.
31. *Physalis Fendleri* A. Gray, (in triplicate), *Fendler*.
32. *P. similas* A. Nels., *Fendler* 575.
33. *Eupatorium Fendleri* A. Gray, *Fendler* 347.
34. *Erigeron cinereus* A. Gray, (in duplicate), *Fendler* 374.

35. *Actinella argentea* A. Gray, (in duplicate), *Fendler* 457.
36. *Actinella Richardsonii* Nutt. var. *floribunda* A. Gray (in duplicate), *Fendler* 460.
37. *Diplopappus ericoides* Torr. & Gray var. *hirtella* A. Gray, (in duplicate), *Fendler* 348.
38. *Bidens tenuisecta* A. Gray, *Fendler* 449.
39. *Agoseris purpurea* (A. Gray) Greene, *Fendler* 487.

For many years there has been a diminishing support for small herbaria, some of which, like the Cleaveland Collection at Bowdoin College, are of historic importance and have scientific value. The space they occupy has been encroached upon by classrooms and by modern research setups. This does not mean that the collections are less important than they ever were. It does suggest that the custodians of such herbaria should take steps, as Bowdoin College has done, to make their specimens available to the scientific community.

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STUDIES ON THE AUDOUINELLA MICROSCOPICA (NAEG.) WOELK. COMPLEX (RHODOPHYTA)

WILLIAM J. WOELKERLING

Several recent studies (Abbott 1962, West 1968, Woelkerling 1970, 1971) have indicated that the taxonomic status of numerous species in the *Audouinella* complex (*Acrochaetium-Rhodochorton* complex) of the red algae is in need of review. Many of these taxa have been described from meagre material and (or) without regard for possible intraspecific variation, and recent work on several species (Abbott 1968, West 1969, Woelkerling 1970) has resulted in a reduction of some taxa to synonomy.

Preliminary work of the author on the audouinelloid algae of the New England coast of North America has led to a detailed consideration of the relationships of *Audouinella microscopica* (Naegeli) Woelkerling to six closely related taxa: *Acrochaetium crassipes* Boergesen (1909, p. 1, Fig. 1; 1915, p. 20, Figs. 11-13), *A. catenulatum* Howe (1914, p. 84, pl. 31, Figs. 12-18), *A. microfilum* Jao (1936, p. 240, pl. 10, Figs. 1-5), *Kylinia collopoda* (Rosenvinge) Kylin (see Rosenvinge 1898, p. 41, Figs. 10-11; 1909, p. 81), *K. compacta* (Jao) Papenfuss (see Jao 1936, p. 241, pl. 10, Figs. 6-14), and *K. moniliformis* (Rosenvinge) Kylin (see Rosenvinge 1909, p. 98, Figs. 28-29). (It should be noted here that although the taxonomic proposals of Woelkerling (1971) have been adopted in this study, older generic names have been employed in cases of probable synonomy in order to avoid making new and unnecessary nomenclatural combinations). *A. crassipes* and *A. catenulatum* were described respectively from material collected in the Virgin Islands (Boergeson 1909) and Peru (Howe 1914) while the other four taxa have been described from or are reported to occur along the New England and adjacent coasts.

These seven species have been distinguished from one another on slight differences in habit, branching, cell size,

chromoplast shape, and spore size. These apparent differences, however, may not be as taxonomically reliable as formerly thought, and Woelkerling (1971) has suggested that several or all of the taxa under discussion may be conspecific. The aims of the present investigation have been: 1) to critically examine and compare morphologically the type collections and other populations of these seven taxa, and 2) to clarify taxonomic limits within this species complex, particularly with reference to the New England flora.

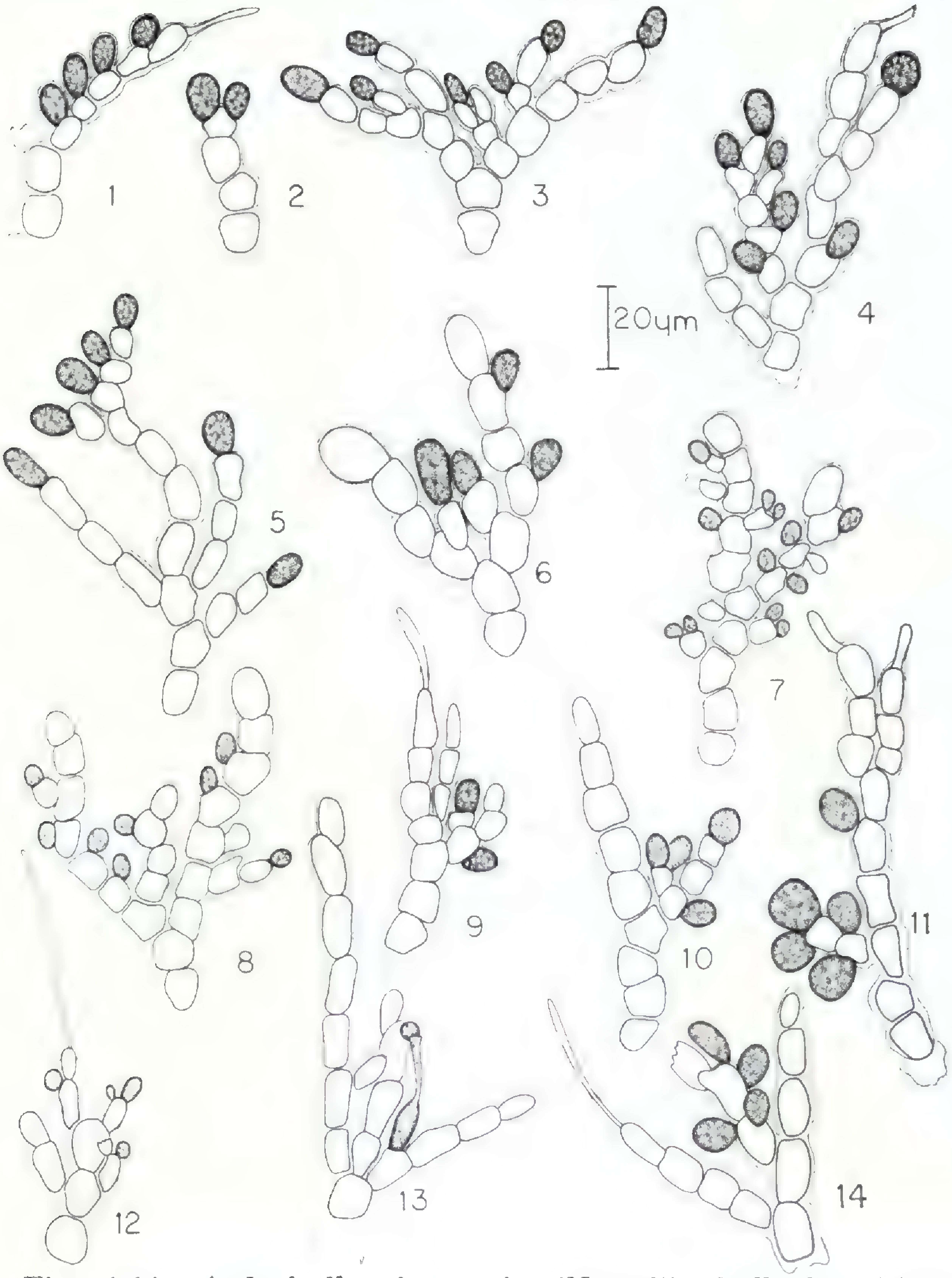
MATERIALS AND METHODS

The morphological techniques employed in these studies have been detailed elsewhere (Woelkerling 1970). Line drawings have been made with the aid of a Leitz drawing head microscope attachment; herbarium abbreviations follow Lanjouw and Stafleu (1964).

Wherever possible, results have been based on the study of populations (Table 1) rather than isolated individuals. This approach has been facilitated by the nature of the material; i.e., audouinelloid algae sometimes occur in large numbers on various substrates and by virtue of their small size, dozens or hundreds of individuals may be present in a single collection. The data presented here in most cases represents the results of study on numerous individuals within each population; an exception is the type collection of *Acrochaetium crassipes* Boergesen which is represented in C only by several drawings. Data on this taxon has been taken from the accounts of Boergesen (1909, 1915).

MORPHOLOGY

Audouinella microscopica, the earliest described member of this complex, was first characterized by Kuetzing (1849), and later Naegeli (1861) discussed and illustrated it in somewhat greater detail. Although Kuetzing (1849, p. 640) cited the Bay of Naples as the type locality, Hamel (1927; 1928) has indicated that the type collection came from Torquay, England and is represented by specimen 454 in Hauck and Richter's "Phykotheca Universalis" (as *Chan-*



Figs. 1-14. *Audouinella microscopica* (Naegeli) Woelkerling. Figs. 1-6. Monosporangial plants from type collection. Note variation in habit and in development of basal cell wall. Figs. 7-8. Spermatangial plants from type collection. Figs. 9-11. Cystocarpic plants from type collection. Note remains of trichogyne and an apparent transversely divided carpogonium (Fig. 9). Figs. 12-14. Sexual plants from Denmark removed from the host, *Chordaria*. Note variation in development of basal cell wall and carpogonium with attached spermatium (Fig. 13).

transsia secundata (Lyngbye) Thuret). The type specimen in the Kuetzing collections at L contains only plants collected by Naegeli in England (identical to those distributed in Hauck and Richter) and none from the Bay of Naples. The location given by Kuetzing (1849) is, therefore, apparently in error.

Plants from the type collection of *A. microscopica* in L as well as isotypes in FH and NY have been examined during this study. The plants form a dense population on *Enteromorpha* (Chlorophyta), are 40-100 (-200) μ tall, and are attached to the host by unicellular bases with or without enlarged lower cell walls (Figs. 1-11). One or occasionally several erect filaments arise from the basal cell (Figs. 3, 4), and these may remain unbranched (Fig. 1-2) or bear several secundly or irregularly arranged laterals (Figs. 3-11). Cells are doliiform to cylindrical in shape, 6-8 (-12) μ wide and 6-12μ (1-2 diameters) long; terminal hairs up to 40μ long occur occasionally.

Both monosporangial and sexual plants are present in the material examined. The monosporangia occur singly or in pairs, are 7-10μ long and 5-7μ wide, are sessile or stalked, and are scattered over the erect filaments (Figs. 1-6). Spermatangia are ovoid, up to 4μ long, occur singly or in pairs, are sessile or stalked and are scattered over the erect filaments (Figs. 7-8). Unfertilized carpogonia have not been observed definitely in the type collection material, but the remains of at least one apparently transversely divided fertilized carpogonium has been seen (Fig. 9). Gonimoblasts are several celled and give rise to terminal or lateral carposporangia 7-10μ long and 6-8μ wide (Figs. 10-11). Only the clustered arrangement of the carposporangia distinguishes the gonimoblast from a monosporangial bearing branch. Tetrasporangial individuals have not been observed but are reported by Schiffner (1931).

Hamel (1927, 1928) previously reported sexual individuals, and Lund (1942) noted possible antheridia in Danish plants. One Danish collection on loan from Dr. Lund has been examined and found to contain numerous sexual in-

dividuals including specimens with carpogonia bearing attached spermatia (Figs. 12-14). Lund (1942) referred the Danish material to *Chantransia* (= *Kylinia*) *collopoda*, a taxon here considered conspecific with *Audouinella microscopica.*

Monosporangial plants more or less agreeing with the above description of *A. microscopica* occur along the New England and adjacent coasts, but up to the present time, they have been referred (Edelstein & McLachlan 1966; Edelstein et. al. 1967; Jao 1936; Taylor 1937, 1957) to four other species (see above) including two (*A. microfilum* and *K. compacta*) with type localities in the Cape Cod region. An analysis (Table 1) of a number of New England populations including those cited by the above authors, strongly indicates that they agree in all essential features with *A. microscopica* and are therefore justifiably referred to that species.

The analysis further indicates that while the range in basal attachment, height, branching, number of erect axes, chromoplast shape, cell size, and spore size may vary somewhat from one population to the next (probably attributable to variation in environmental factors and age), considerable overlap in these characters exists between various collections and in no cases can distinct specific limits be drawn. Consequently, it appears that all these plants are best regarded as members of a single, variable species — *A. microscopica.* Woelkerling (1971) has found similar variation in southern Australian populations of this species.

Ecological data on *A. microscopica* in New England remains scant. Specimens have been collected from July through February, but the species probably occurs throughout the year and has thus far escaped detection by virtue of its small size. Sexual plants have not been reported to date in New England, and indeed have been recorded only twice from European waters. *A. microscopica* has been found growing on a number of algae in New England waters (*Chaetomorpha, Chondria, Chondrus, Chordaria, Cladophora, Entromorpha, Polysiphonia, Porphyra*) all of which

occur in the sublittoral or in the drift. The species no doubt enjoys a much wider host distribution and is to be sought particularly on old and heavily epiphytized algae.

SYSTEMATIC IMPLICATIONS

The results of this study again (see Woelkerling 1971) raise the question as to whether a number of taxa closely related to *Audouinella microscopica* are really distinct species. The type collections of six of these taxa have been available for study, and a detailed analysis (Table 1) strongly indicates that taxonomic distinctions cannot be made among them on the bases of height, number of erect axes, cell size, or spore size. As is the case for the various New England collections, considerable overlap in the above characters is evident in the type collection populations, and specific limits cannot be clearly drawn. Moreover, a comparison of the type collection illustrations (see Boergesen 1909; Howe 1914; Jao 1936; and Rosenvinge 1909) also indicates the great similarity of these taxa.

In addition to the above characteristics, apparent differences in habit, development of the basal cell wall, degree of branching, origin of laterals, chromoplast shape, presence or absence of hairs, and position of sporangia have been used in making specific distinctions. As Woelkerling (1971) has shown in a lengthy review, the degree of branching, presence or absence of hairs, and sporangial position are not taxonomically reliable in general for making specific distinctions in the *Audouinella* complex, and the present study supports this view. Thus, for example, the type collection of *A. microscopica* contains plants which vary in the degree of branching, may or may not have unicellular hairs, and possess both terminal and lateral sporangia (Figs. 1-11).

Hamel (1927, 1928) attempted to distinguish *A. microscopica* from other members of this complex on the basis of lateral branch origin. Thus, according to Hamel, the first lateral branch in *A. microscopica* always arises from the first cell above the base. The type collection of this species,

however, also contains unbranched plants (Figs. 1-2) and plants in which the lateral arises from the basal cell (Fig 4) or from two or more cells above the base (Figs. 9-11). Woelkerling (1971) found similar variation in Australian populations of *A. microscopica*, and this variation also occurs in New England populations. Thus it appears that specific distinction based on origin of lateral branches is not taxonomically reliable.

The presence of a much enlarged basal cell wall has been used (Rosenvinge 1898, 1909; Lund 1942) to distinguish *Kylinia collopoda* from *Audouinella microscopica*. However, considerable variation in basal cell wall development occurs in the type collection of *A. microscopica* (Figs. 1-11) as well as collections made by Lund (Figs. 12-14), and Woelkerling (1971) reported a similar situation in southern Australian populations of this species. This variation suggests that this character also is not taxonomically reliable for delimiting species in this complex.

Chromoplast shape (parietal vs. stellate) has also been used (Taylor 1957) to distinguish these species. However, recent work (West 1968, p. 92, 95; Woelkerling 1971) has indicated that plastid shape shows considerable intraspecific variation and therefore is not a generally trustworthy taxonomic criterion. Some variation has already been recorded in plastids of *A. microscopica* (Woelkerling 1971), and studies (e.g., Abbott 1962, p. 100; Boergesen 1937, p. 39, 41; Drew 1928, p. 156, 176, 177, 182; Feldmann 1962, p. 220; Levring 1937, p. 94) have noted similar variation in other species. It appears, therefore, that the taxa under discussion cannot be distinguished from one another solely on apparent differences in chromoplast shape.

This study has not revealed any other criteria by which these taxa may be reliably separated into distinct species; consequently all are regarded here as conspecific with *Audouinella microscopica*.

The relationships of *A. microscopica* to four other taxa remain uncertain, primarily because the type collections have not been available for examination. The taxa include

Chantransia meditierranea Levring (1942, p. 30, Figs. 1a-g), *C. minutissima* Reinsch (1874-5, p. 33, tab. V, Fig. 2a, tab. XI, Fig. 3a; not of other authors), *C. trifila* Buffham (1892, p. 24, pl. 3, Figs. 1-4), and *Kylinia scapae* Lyle (1929, p. 245, Figs. 6-7). A comparative examination of the type collections of these taxa will almost certainly show them to be conspecific with *A. microscopica.* The androphores described and illustrated by Lyle (1929) probably represent young, unelongated unicellular hairs.

COLLECTIONS EXAMINED

Types and Isotypes: DENMARK: Kattegat Channel, 17. vii. 1890, *Rosenvinge* (C, Rosenvinge 863, Algae marinae Danicae, type of *Chantransia moniliformis* Rosenvinge). ENGLAND: Torquay, 1845, *Naegeli* (L 940285 . . . 306, type of *Audouinella microscopica* (Naegeli) Woelkerling). Torquay, 1845, *Naegeli* (FH, No. 454, "Phykotheka Universalis", isotype of *A. miscroscopica*). Torquay 1845, *Naegeli* (NY, No. 454, "Phykotheka Universalis", isotype of *A. microscopica*). GREENLAND: Holstenborg, 9. vii. 1895, *Hanson* (C, type of *Chantransia collopoda* (Rosenvinge) Rosenvinge). PERU: La Punta, region of Callao, 25. i. 1907, *Coker* (NY, type of *Acrochaetium catenulatum* Howe). UNITED STATES: Black Rock, Sconticut Neck, New Bedford, Massachusetts, 25. vii. 1934, *Jao* (MICH, Woods Hole, No. 275, type of *Acrochaetium compactum* Jao). Norton Point, Martha's Vineyard, Massachusetts, 3. viii. 1934, *Jao* (MICH, Woods Hole, No. 280 [not 274 as reported by Jao 1936, p. 240], type of *Acrochaetium microfilum* Jao). VIRGIN ISLANDS: St. Thomas (The Harbour), i. 1906, *Boergesen* (C, type of *Acrochaetium crassipes* (Boergesen) Boergesen).

Other collections: DENMARK: Vorupor, NW coast of Jutland, 30. vii. 1929, *Lund* (C). MASSACHUSETTS: Cape Codder Point (Falmouth), 19. xi. 1969, *Woelkerling* (2292, personal collection). West Falmouth Harbor, 17. x. 1970, *Woelkering* (2826, personal collection). Woods Hole (Nobska Point), 4. ii. 1970, *Woelkerling* (2320, personal

collection). NOVA SCOTIA: Cranberry Cove, 12. ix. 1965, *Edelstein* (Nat. Res. Council. Herb., Halifax, No. 1867, as *Acrochaetium microfilum* Jao). Herring Cove, 18. i. 1966, *Edelstein* (Nat. Res. Council. Herb., Halifax, No. 2217, as *Kylinia compacta* (Jao) Papenfuss). Ketch Harbour, 7. ii. 1966, *McLachlan & Edelstein* (Nat. Res. Council. Herb., Halifax, No. 2244, as *Kylinia collopoda* (Rosenvinge) Papenfuss). Peggy's Cove, 26. viii. 1965, *Edelstein* (Nat. Res. Council. Herb., Halifax, No. 2105, as *K. collopoda*).

SUMMARY

The relationship of *Audouinella microscopica* to six closely related taxa has been investigated with particular reference to the New England and adjacent coasts. The morphology of monosporangial and sexual plants in the type collection of *A. microscopica* is discussed and illustrated. Collections from the New England region previously referred to *Acrochaetium microfilum* Jao, *Kylinia collopoda* (Rosenvinge) Kylin, *K. compacta* (Jao) Papenfuss, and *K. moniliformis* (Rosenvinge) Kylin have been found to represent specimens of *Audouinella microscopica*. A comparative study of the type collections of these five taxa as well as *Acrochaetium crassipes* Boergesen and *A. catenulatum* Howe indicates that all taxa are conspecific with *Audouinella microscopica*. *Chantransia meditierranea* Levring, *C. minutissima* Reinsch non. al., *C. trifila* Buffham, and *Kylinia scapae* Lyle are regarded as probable synonyms.

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TABLE I. MORPHOLOGICAL DATA ON POPULATIONS OF *A. MICROSCOPICA COMPLEX*[1]

No.	Name	No. of Erect Axes	Height	Cell Width	Cell Length	L/W Ratio	Spore Length	Spore Width
1	"CATENULATUM"	1	40-140μ	7-11μ	7-10μ	1	9-11μ	6-7μ
2	"COLLOPODUM"	3	20-200μ	7- 9μ	10-15μ	2-4	8-15μ	7-8μ
3	"COMPACTUM"	(2-)3(-4)	20- 50μ	5- 8μ	5-10μ	1-2	6- 8μ	5-7μ
4	"CRASSIPES"	1 (-2)	40- 60μ	5- 7μ	5- 9μ	1-2	6- 8μ	5-7μ
5	"MICROFILUM"	3-4	20- 40μ	3- 6μ	4- 7μ	1	6- 8μ	4-6μ
6	"MICROSCOPICUM"	1 (-2)	40-200μ	6-12μ	6-12μ	1-2	7-10μ	5-7μ
7	"MONILIFORMIS"	2-3	40-150μ	7-11μ	7-14μ	1-2	11-15μ	6-7μ
8	N. England Populations	1-4	20-100μ	3-10μ	3-11μ	1-2	6-15μ	4-9μ
9	Australian Populations	1-3(-4)	20-140μ	3-12μ	3-10μ	.75-2	5-10μ	4-7μ

[1]Data for the first seven populations is based on an examination of the type collections of those taxa; No. 8 represents a composite of data from all New England collections examined; No. 9 represents data from Woelkerling (1971).

NOMENCLATURAL CLARIFICATION OF TWO SPECIES OF VERBESINA (COMPOSITAE) ENDEMIC TO FLORIDA[1]

JAMES R. COLEMAN

Two species of *Verbesina* are evidently endemic to Florida. One of these is restricted to a few coastal counties of the Apalachicola region of western Florida whereas the second has been collected from several counties in northeastern Florida. The species are disjunct by approximately 150 miles and are readily distinguished from each other by several morphological features. Most notably, the eastern species has decurrent leaves which form winged stems and has rayed heads whereas the western species has wingless stems and rayless heads. I have examined approximately 50 collections of these species and have observed no exceptions to these differences.

In 1822 Nuttall was the first to describe the eastern species, naming it *Actinomeris pauciflora* and in 1841 he elaborated on his original description. *Actinomeris pauciflora* was described as having decurrent leaves and 3-4 rays. The description was based on a collection made by Ware. I have been unable to locate this specimen and do not know whether it still exists. However, there is no doubt as to the species being described.

In 1872 Chapman applied the name *A. pauciflora* Nutt. to a coastal species from western Florida. The species was described as having wingless stems and the florets as having "the marginal ones abortive." Chapman's lucid description leaves no doubt that he was erroneously applying the name *A. pauciflora* Nutt. to the species from the Apalachicola region. In 1878 Chapman, evidently still unaware of his error, redescribed the eastern species as new, giving it the name *Actinomeris heterophylla*. He described *A. heterophylla* as having winged stems, 5-10 rays and as oc-

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[1]This investigation was supported by National Science Foundation Grant GB-13923.

curring in eastern Florida. I have examined the type and it clearly belongs to the eastern species.

The next event in the nomenclatural history of these species occurred in 1883 when Gray transferred the eastern species to *Verbesina* forming the combination *V. heterophylla* (Chapm.) A. Gray. Although no description was provided, Gray did list *Actinomeris heterophylla* Chapm. as a synonym. The description Gray provided in his Synoptical Flora (1884) clearly reveals that he was referring to the eastern species. In his 1883 publication Gray also transferred *A. pauciflora* Nutt. to *Verbesina.* However, since the specific epithet was preoccupied by a Mexican *Verbesina* described by Hemsley in 1881, he formed the new name *Verbesina warei* A. Gray and gave *Actinomeris pauciflora* Nutt. as a synonym. Gray's description of *Verbesina warei* in his Synoptical Flora is confusing in that he described the stems as wingless but described the heads, in quotes, as being 3-4 rayed. He stated that the species occurs near the coast but did not specify the eastern or western coast. Collections by Ware and by Chapman were cited; however, Chapman collected both species and, as far as I am aware, Ware collected only the eastern. There is, therefore, serious doubt as to whether Gray was applying the name *Verbesina warei* to the eastern or western species. These species had been very infrequently collected prior to 1884 and it is possible that Gray never saw specimens of one or the other or either species. It appears probable that Gray compiled his description of *V. warei* largely or entirely from Nuttall's and Chapman's descriptions of *Actinomeris pauciflora* Nutt. It should be recalled that Chapman's description was actually of the eastern species. Were this assumption true, it could account for the mixing of characteristics of both species in Gray's description of *Verbesina warei,* for his use of quotes in referring to the rayed condition and to his failure to indicate whether the species occurred on the east or west coast as the two descriptions conflict on this point. In citing the collections of Ware and Chapman, Gray was probably again simply following Nuttall and Chapman.

In their revision of the genus *Verbesina,* Robinson and Greenman (1899) applied the name *Verbesina heterophylla* A. Gray to the eastern species and listed *Actinomeris heterophylla* Chapm. in synonymy. The western species was called *Verbesina warei* A. Gray and *Actinomeris pauciflora* Nutt. was given as a synonym.

Small (1903), in his Flora of the Southeastern United States, also called the eastern species *Verbesina heterophylla* (Chapm.) A. Gray, but formed a new combination, *Verbesina pauciflora* (Nutt.) Small, for the western species and listed both *Actinomeris pauciflora* Nutt. and *Verbesina warei* A. Gray in synonymy. Small also was evidently unaware that Nuttall's name was originally applied to the eastern species and was either unaware of, or ignored, the fact that the combination *Verbesina pauciflora* was preoccupied.

Alexander, in treating these species in Small's Manual of the Southeastern United States (1933), transferred both to the genus *Pterophyton,* forming the new combination *P. pauciflorum* (Nutt.) Alex. for the western species and *P. heterophyllum* (Chapm.) Alex. for the eastern species. The genus *Pterophyton* Cass. had been reduced to a section of *Verbesina* by Torrey and Gray in 1842. This reduction appears justified when the genus *Verbesina* is considered in its entirety rather than on a regional basis.

The question arises as to the correct names for the two species under consideration. Although the earliest binomial applied to the eastern species is *Actinomeris pauciflora* Nutt. (1822), the epithet *pauciflora* cannot be used in combination with *Verbesina* since the combination *V. pauciflora* is preoccupied by Hemsley's Mexican species. The second oldest binomial given to this species is *Actinomeris heterophylla* Chapm. (1878), the specific epithet of which was transferred by Gray to form the correct name for the eastern species, *Verbesina heterophylla* (Chapm.) A. Gray.

Although *Verbesina warei* A. Gray has been used fairly commonly for the western species, Gray did give *Actinomeris pauciflora* Nutt. as a synonym in making the transfer.

The name *Verbesina warei* A. Gray is, therefore, associated with the type of *Actinomeris pauciflora* which belongs to the eastern species. *Verbesina warei* must then be considered a synonym of *V. heterophylla* (Nutt.) A. Gray.

Verbesina heterophylla (Chapm.) A. Gray, Proc. Amer. Acad. **19**: 12, 1883.

Actinomeris pauciflora Nutt., Sill. Journ. 5: 301, 1822; Trans. Amer. Phil. Soc. 7: 364, 1841. Type: East Florida, *Ware* s.n. (location unknown).

Actinomeris heterophylla Chapm. in Coult., Bot. Gaz. 3: 6, 1878. Type: East Florida, *Chapman* s.n., 1871. (NY!)

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Pterophyton heterophyllum (Chapm.) Alex. in Small, Man. S. E. Fl. 1444, 1933.

The earliest description of the western species was given by Chapman in 1872; however, he failed to recognize it as a new species and misidentified it as *Actinomeris pauciflora* Nutt. Probably the most commonly used name for this species is *Verbesina warei* A. Gray. However, this name belongs to the eastern species. Since the western species has never been given a valid name, it is described as a new species.

Verbesina chapmanii J. R. Coleman, sp. nov. Perennis ca 0.5-1.1 m alta; caulis simplex non alatus; folia opposita vel alterna, sessilia vel subsessilia, lanceolata, elliptica vel lata, scabra; capitula 1-5 terminalia pedunculata, plerumque 1-2 cm lata, discoidea; involucra 2-seriata, ca 8-12 mm elliptico-oblonga, plerumque 5-9 cm longa, usque ad 3.2 cm alta; flores lutei; achaenia alata, oblongo-obovata, plerumque 6-8 mm longa, 4-5 mm lata, glabra vel subglabra, epapposa vel pappi setis usque ad ca 1 mm longis praedita.

Perennial herbs mostly 0.5-1.1 m tall with heavy rhizomes; stems numerous, unbranched below the inflorescence, wingless, hispidulous near the heads, otherwise glabrous or subglabrous; leaves alternate or opposite, be-

coming bractiform above, rigid, sessile or subsessile, lanceolate, elliptical or elliptic-oblong, serrulate to subentire, obtuse or less frequently acute, to ca 12 cm long, commonly 5-9 cm long, to ca 3.2 cm wide, scabrous; inflorescence solitary or to 5-headed; heads mostly 1-2 cm wide, discoid; phyllaries 2-seriate, ca 8-12 cm tall; florets yellow, mostly 12-14 mm tall; paleae ca 8-10 mm tall, mostly red-purple apically; achenes mostly red-purple, oblong-obovate, mostly 6-8 mm long, 4-5 mm wide, glabrous or sparingly hirtellous apically, lateral wings to ca 1 mm wide, continuous about the crown to form a shallow cup, pappus of 2 short horns or lacking.

Type: open prairie-like pine-cypress savanna, 3 mi N of Orange, Liberty Co, Florida, *McDaniel* 4468 (GH!)

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SOMATIC CHROMOSOME NUMBERS FOR SOME ASTERACEAE

MILOSLAV KOVANDA

Few plant groups can claim the attention of botanists that the American Asteraceae have been enjoying in recent years. In addition to thorough monographic studies an unprecedented series of chromosome number reports has appeared, and it may seem trivial to publish additional counts for a handful of miscellaneous taxa. Yet the need for repeated chromosome sampling cannot be stressed enough. Previous studies have revealed that intraspecific polyploidy is widespread, and chromosome counts from as many populations as possible throughout the range of each species are required to gain an idea of the nature and significance of this diversity. Many of the taxa discussed below are wide-ranging, polymorphous entities that have been counted but once or twice, making the "cytofloristic" approach imperative. The counts for *Artemisia saxicola* and *Haplopappus lyalli* are believed to be the first to be published for these species. A new ploidy level is established for *Chrysopsis fulcrata.*

MATERIALS AND METHODS

All chromosome counts were obtained from squashes of root-tips of young seedlings grown in the laboratory. Achenes were collected in the field in the late summer and fall of 1970. All germinated without special treatment in 2 to 9 days when placed on moist filter paper in Petri dishes and maintained at room temperature. Excised root-tips were pretreated in a saturated solution of 8-hydroxyquinoline for 3 hours, fixed in 1 : 3 acetic alcohol, and stained in lacto-propionic orceine (for details, see Kovanda 1970). The counts were verified in five or more plantlings. Voucher specimens were collected for all plants sampled and will be deposited at the Herbarium of the National Museum in Prague (PR). Duplicates, when available, will be deposited

in the United States National Herbarium (US). A portion of the material examined has been planted in the experimental plot of the Botanical Institute, Czechoslovak Academy of Sciences, Prague, for future observations. All collections were made by Kovanda or by Kovanda and S. G. Shetler.

OBSERVATIONS

TRIBE VERNONIEAE

1. *Elephantopus carolinianus* Willd.
Maryland, Montgomery County: thicket along Chesapeake & Ohio Canal near Glen Echo, vicinity of Washington, D.C., *Kovanda* 3558. $2n = 22$.

This species recently has been examined cytologically from two widely separated areas: Virginia (Baldwin & Speese, 1955) and Texas (Lewis et al., 1962). In both cases, the authors report the same chromosome numbers, $2n = 22$ and $n = 11$, respectively. The entire genus seems to have the base number $x = 11$, and all species counted heretofore have proved to be diploid. The count $2n = 44$ for *E. tomentosus* L., ascribed by Fedorov et al. (1969) to S. B. Jones (1966), is in error, Jones having counted $n = 11$ and listed the earlier count of $2n = 22$ made by Baldwin & Speese.

TRIBE EUPATORIEAE

2. *Eupatorium coelestinum* L.
Maryland, Montgomery County: dry woodland near Cabin John Bridge, vicinity of Washington, D.C., *Kovanda* 3529. $2n = 20$.

This number was reported previously by Grant (1953) for material from Pennsylvania, Kentucky, and Tennessee. By its chromosome morphology this species differs from all other species of *Eupatorium* having $x = 10$ and would be best referred perhaps to the genus *Conoclinium* DC. (see Grant 1953).

3. *Liatris punctata* Hook.
Colorado, Larimer County: Rist Canyon, grassy roadside about 8 mi. W. of Bellevue, 6800 ft., *Kovanda & Shetler* 3169. $2n = 40$.

In her study of the genus *Liatris*, Gaiser (1950) has demonstrated that two chromosome races exist in this species, which she was able to identify with previously described infraspecific taxa. Diploids ($2n = 20$) have been referred to var. *nebraskana* Gaiser, and the tetraploid level ($2n = 40$) is represented in var. *punctata* (var. *typica* Gaiser) and var. *mexicana* Gaiser. The two cytotypes are not always easily recognizable on a morphological basis but show, in addition to marked differences in the beginning of anthesis, also a clear geographical separation. Tetraploids seem to occur throughout most of the extensive range of the species (with var. *mexicana* being limited to its southern part) while the diploid variety is obviously localized. The Rist Canyon population certainly falls within the typical variety but approaches somewhat var. *nebraskana* by its leaves which are almost entirely devoid of cilia.

TRIBE ASTEREAE

4. *Aster occidentalis* (Nutt.) T. & G.
Colorado, Larimer County: brushy hillside north of Stove Prairie School, S. of Poudre River, 6500 ft., *Kovanda & Shetler* 3183. $2n = 16$.

The count reported here is consistent with those published by Huziwara (1958, 1959) and Solbrig et al. (1969). The Western Aster is one of the few aster species not in the $x = 9$ series. The number $x = 8$, likewise $x = 5$ in *A. exilis* Ell. and *A. foliaceus* Lindl., and $x = 13$ in *A. chilensis* Nees, is clearly secondary (Solbrig et al., 1969). Other species with $x = 8$ include, for instance, *A. adscendens* Lindl., *A. ericoides* L., *A. hirtifolius* Blake, *A. lateriflorus* (L.) Britt., and *A. puniceus* L.; most of them are tetraploid, with $2n = 32$. It is interesting to note that base numbers other than $x = 9$ are not known to occur in species native to the Old World, which supports the contention that the center of origin of this huge genus is America.

5. *Chrysopsis fulcrata* Greene
Colorado, Clear Creek County: abandoned campground in Clear Creek valley, about 12 mi. south of Georgetown, 11,440

ft., *Kovanda & Shetler* 3331. $2n = 18$.
Colorado, Larimer County: Rist Canyon, grassy roadside about 8 mi. west of Bellevue, 6800 ft. *Kovanda & Shetler* 3172. $2n = 36$.

Counts by Raven et al. (1960), Turner et al. (1962), Solbrig et al. (1964), Chuksanova et al. (1968), and Solbrig et al. (1969) indicate that both diploids and tetraploids are present in the *Chrysopsis villosa* species aggregate. In *C. fulcrata*, a segregate defined mainly by leaf-like bracts subtending the heads, glandular phyllaries and sessile leaves, only the diploid level ($n = 9$) has been sampled (Solbrig et al. 1964, 1969). An examination of material from Rist Canyon clearly showed 36 somatic chromosomes. The collection was compared with Greene's type material of *C. fulcrata* in the U. S. National Herbarium, and no specific differences could be seen except for the leaves. These are sometimes slightly tapering at the base in my plants but are distinctly semi-amplexicaul in the type specimen, collected in the Organ Mountains, New Mexico. In the Clear Creek diploid this tapering is even more conspicuous, marking an intergradation with *C. hispida* (Hook.) DC. and *C. viscida* (A. Gray) Greene. The taxonomy of the entire complex is not very well understood, and there appears to be little correlation between the cytological findings and morphological segregation of the several species.

6. *Chrysothamnus nauseosus* (Pallas) Britt. subsp. *nauseosus*
Wyoming, Albany County: stony roadside just east of Centennial, 8000 ft., *Kovanda & Shetler* 3205. $2n = 18$.

The Rabbitbrush was the subject of a detailed cytotaxonomic study by Anderson (1966) who demonstrated that polyploidy is rare in this genus. He found only the diploid number $2n = 18$ in many plants of *C. nauseosus* divided among 12 subspecies. The same number has been counted by Raven et al. (1960) and Solbrig et al. (1964). The count reported here is only a further proof (if one is needed) that the astonishing morphological variation shown by this species cannot be credited to polyploidy.

7. *Erigeron speciosus* (Lindl.) DC.
Wyoming, Teton County: Teton Pass, 9000 ft., *Kovanda & Shetler* 3252. $2n = 18$.

Previous counts seem to indicate that this species comprises diploid and tetraploid cytotypes. Ferri (1961), Zhukova (1964, 1967) and Huziwara (1965) give, alternatively, $n = 9$ or $2n = 18$, contrasting with $2n = 36$ counted by Vilmorin and Chopinet (1954). Unfortunately, all these counts were made on cultivated material of uncertain origin, and it remains to be seen whether both the races occur in natural habitats. The Teton Pass population proved to be diploid and appears referable to var. *macranthus* (Nutt.) Cronquist, which has been counted as *E. macranthus* Nutt. by Bergman (1942) and Zhukova (1964). Both counts were $2n = 18$, too, but the sources of the material were not given.

8. *Grindelia aphanactis* Rydb.
New Mexico, Rio Arriba County: Rio Grande Canyon, about 5 mi. NE. of San Juan Pueblo, 5800 ft., *Kovanda* 3404. $2n = 24$.

The only previous count for this species was $n = 12$ by Raven et al. (1960) on material from Arizona. *Grindelia* Willd. is a natural genus, and, chromosomally, a very homogeneous one, with the base number only $x = 6$. The majority of species seem to be diploid, with $2n = 12$ (see also Whitaker and Steyermark 1935, Dunford 1964, 1970).

9. *Haplopappus lyallii* A. Gray
Colorado, Clear Creek County: Loveland Pass, 11,900 ft., *Kovanda & Shetler* 3382. $2n = 18$.

No previous cytological work seems to have been done on this tiny goldenweed. Two members of the section *Tonestus*, *H. eximius* Hall and *H. peirsonii* (Keck) Howell, have been shown to have $2n = 18$ and ca. 90, respectively (Stebbins *in* Howell 1950), which would indicate that the base number for that group is 9. But considering the variety of chromosome numbers encountered in other species (see e.g., Raven et al. 1960, Solbrig et al. 1964, 1969), any such statement would be premature. In the genus *Haplopappus*,

as broadly conceived by Hall (1925), $x = 9$ as a basic chromosome number is not uncommon; however, it is puzzling to discover that it is largely associated with the shrubby groups of the southwestern deserts, such as sections *Ericameria* and *Stenotopsis*. The only other herbaceous species hitherto known to have the base number $x = 9$ is *H. clementis* (Rydb.) S. F. Blake of the section *Pyrrocoma*. The genus *Tonestus* was proposed by Nelson (1904) to accommodate low perennial herbs from the Rocky Mountains area and "to bring together under one name these species [*H. laceratus* Henderson, *H. lyallii* A. Gray, and *H. pygmaeus* T. & G.] which are allied by habit and morphological characters to each other and are aberrant in any recognized genus or genera in which they can be placed." When more cytological information is available, it may become necessary to reconsider the generic and sectional limits.

10. *Solidago flexicaulis* L.
Maryland, Harford County: woodland along Susquehanna River below Deer Creek, between Schweers Landing and Lapidum, *Kovanda & Shetler* 3638. $2n = 18$.

The same diploid number has been found in plants from several Canadian localities (see Beaudry and Chabot 1959, Kapoor and Beaudry 1966, Kapoor 1970). A tetraploid cytotype was reported from Michigan (Solbrig et al. 1964).

11. *Solidago multiradiata* Ait.
Colorado, Clear Creek County: Clear Creek valley, about 12 mi. west of Georgetown, 11,400 ft., *Kovanda & Shetler* 3372. $2n = 18$.

This arctic-alpine species was once thought to be diploid (Beaudry and Chabot 1959, Beaudry 1963) but has recently been shown to have tetraploid races, $2n = 36$, in western Canada and Alaska (Taylor 1967, Johnson & Packer 1968, Packer 1968). The count recorded here is the first made on material from the Southern Rockies where the species reaches its southernmost limit. The collection is var. *scopulorum* A. Gray.

12. *Solidago sempervirens* L.
Delaware, Sussex County: salt marsh about 2 mi. S. of Rehoboth Beach, *Kovanda* 3589. $2n = 18$.

Several counts have been made on this halophyte, revealing the presence of diploid and tetraploid levels. However, these races do not correspond with the two major segments recognized taxonomically within *S. sempervirens.* The southern entity, var. *mexicana* (L.) Fern., was first reported to be diploid but was later found to have also $2n = 36$, and the same holds for the more northern var. *sempervirens* (Goodwin 1937, Beaudry and Chabot 1959, Beaudry 1963, Kapoor 1970). Likewise, the geographical distribution of the cytotypes does not seem to form a definite pattern, but there are too few counts to allow any generalization. Their morphological differences and ecological preferences, if any, also await future research.

TRIBE HELIANTHEAE

13. *Rudbeckia hirta* L.
Maryland, Frederick County: Catoctin Mountains, old field near cabin of David Scott, west of Thurmont, *Kovanda* 2896. $2n = 38$.
Colorado, El Paso County: Pikes Peak, 9000-foot level, streamside, *Kovanda & Shetler* 3398. $2n = 38$.

Rudbeckia hirta is an extremely variable species, and many local variants have been given varietal or specific rank. Perdue (1957) greatly reduced their number by recognizing five geographical varieties: var. *hirta,* var. *pulcherrima* Farwell, var. *corymbifera* Fernald, var. *angustifolia* (T. V. Moore) Perdue, and var. *floridana* (T. V. Moore) Perdue. Most controversial perhaps is the treatment of var. *pulcherrima* which was first described as *R. serotina* Nutt. and to which both the populations sampled by the present author belong. Fernald (1948) considered it a western entity which had spread eastwards, becoming thoroughly naturalized throughout most of the United States, and advocated its specific status. His ideas, however, received little support from later workers (Perdue 1957, Core 1962). In contrast to its intricate morphological struc-

ture, the species complex appears remarkably uniform in cytology, $2n = 38$ being the only chromosome number so far obtained (Battaglia 1946, 1947, Perdue 1959). The same chromosome number has also been reported for *R. serotina* (Battaglia 1947, Mulligan 1959).

14. *Viguiera multiflora* (Nutt.) S. F. Blake
Utah, Daggett County: Uinta Mountains, between Cub Creek and Y Creek, ca. 6 mi. W. of Red Canyon Road, 8500 ft., *Kovanda & Shetler* 3275. $2n = 16$.

Two earlier counts for this species give the gametic chromosome number as $n = 8$ (Heiser and Smith 1955, Heiser 1963).

TRIBE HELENIEAE

15. *Hymenoxys richardsonii* (Hook.) Cockerell
New Mexico, Santa Fe County: 2 mi. NE. of Santa Fe, 7200 ft., *Kovanda* 3428. $2n = 30$.

The chromosome number of this species has been determined repeatedly as either $n = 15$ or $2n = 30$ (Speese and Baldwin 1952, Strother 1966). The count $2n = 28$, made by Taylor and Brockman (1966) on a collection from Saskatchewan, suggest that there are two chromosome races in this species whose morphology and geographical distribution require further study. Material examined by the present author belongs to var. *floribunda* (A. Gray) Parker and was collected in or near the type locality ("rocky hills, as well as plains and creek bottoms, around Sante Fe", A. Gray in Mem. Amer. Acad., n.s. 4: 101, 1849).

16. *Pericome caudata* A. Gray
New Mexico, Santa Fe County: Sangre de Cristo Mountains, along the Chamisa Trail, 7600 ft., *Kovanda* 3426. $2n = 36$.

Pericome caudata has recently been counted by Turner and Flyr (1966) and Powell (1968). Both obtained a gametic chromosome number of $n = 18$. Raven and Kyhos (1961) have found the same number in the closely related *P. glandulosa* Goodm. It would appear that the small genus *Pericome* has the base number $x = 9$.

TRIBE ANTHEMIDEAE

17. *Artemisia borealis* Pallas

Colorado, Clear Creek County: Loveland Pass, 11,990 ft., *Kovanda & Shetler* 3376. $2n = 18$.

Artemisia borealis is taxonomically complex in the Old and New World, and attempts to subdivide it into more natural entities have not been very successful. Diploids and tetraploids, based on $x = 9$, are known to exist in this group. Both these races have been shown to occur in North America, but their disposition is not at all clear. Diploids ($2n = 18$) have been discovered in Greenland (Jörgensen et al. 1958), northern Quebec (Hedberg 1967), and Alberta (Packer *in* Johnson and Packer 1968), but tetraploids ($2n = 36$) have so far been found only in Alaska (Johnson and Packer 1968). The Loveland Pass record is important because the count was made on material from the most southern portion of the species range. The plants examined have basal leaves three times pinnatifid, densely hairy on both surfaces; stems almost totally glabrous; heads erect, arranged in a narrow, spike-like inflorescence, somewhat interrupted in the lower half; phyllaries villous; achenes silky-hairy.

18. *Artemisia frigida* Willd.

Colorado, Park County: 2 mi. N. of Fairplay on Route 9, 9900 ft., *Kovanda & Shetler* 3379. $2n = 18$.

This number was obtained previously by Löve and Löve (1964) on plants from Manitoba and by Knaben (1968) on plants from Alaska. Kawatani and Ohno (1964) give $2n = 18$ for garden material of unspecified origin.

19. *Artemisia saxicola* Rydb.

Colorado, Grand County: alpine tundra above Berthoud Pass, 12,400 ft., *Kovanda & Shetler* 3324. $2n = 18$.

Colorado, Summit County: near Pass Lake, just S. of Loveland Pass, 11,000 ft., *Kovanda & Shetler* 3367. $2n = 18$.

These are probably the first counts for the Rocky Mountains segregate of *A. arctica* Less. This species, ranging in northeastern Asia and northwestern North America and

itself a segregate of the European *A. norvegica* Fries, has been counted many times on Asiatic material and is known to have two chromosome numbers, $2n = 18$ and 36. (Kitamura 1957, Sokolovskaya 1963, Kawatani and Ohno 1964, Zhukova 1964, 1965, 1967). Only two records are available from North America (Johnson and Packer 1968, Taylor and Mulligan 1968). Both counts are tetraploid and were made on plants from Alaska and the Queen Charlotte Islands, respectively. It is extremely interesting to discover that the Rocky Mountain populations are diploid and, therefore, more primitive than the northern *A. arctica.* This, combined with the geographical isolation and a degree of morphological differentiation, would justify the specific rank assigned to this race by Rydberg but disregarded by most later students.

TRIBE SENECIONEAE

20. *Senecio longilobus* Benth.
New Mexico, Santa Fe County: near Bishop's Lodge, N. of Santa Fe, 6900 ft., *Kovanda* 3425. $2n = 40$.

This number conforms to the findings of Jackson (1959) and Ornduff et al. (1967) who determined $n = 20$ on plants from New Mexico and Texas. Powell and Turner (1963) have reported the same chromosome number for Mexican material under the name of *S. filifolius* Nutt. The section *Suffruticosi,* confined to the western United States and northern Mexico, appears chromosomally uniform. All species hitherto examined have proved to have $n = 20$ (Stoutamire and Beaman 1960; Turner, Ellison and King 1961; Ornduff et al. 1963, 1967), and Ornduff et al. (1963) have proposed that the base number is either $x = 10$ or $x = 20$.

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INSTITUTE OF BOTANY
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PRAGUE

INTERACTIONS BETWEEN APIS MELLIFERA (HYMENOPTERA: APIDAE) AND TRIBULUS CISTOIDES (ZYGOPHYLLACEAE)

DANIEL F. AUSTIN

In southern Florida a common weed of disturbed areas is *Tribulus cistoides* L. (Burr Nut or Puncture Vine). A frequent visitor to this plant is the Honey Bee, *Apis mellifera* L. Little is known about the reproductive biology of this weedy plant (Porter, 1971; pers. comm.), but observations in Florida suggest some interesting interactions between *Apis* and *Tribulus.*

According to Grant (1950) there is a division of labor among field bees of *Apis mellifera.* Some of the workers carry water; others gather pollen, nectar or propolis, while others search for new food sources. The constancy of an individual to her job and to a particular plant species has been amply verified by numerous authors and summarized by Grant (op. cit.).

While I have observed Hemiptera, Lepidoptera, Diptera, and other Hymenoptera on *Tribulus* in Florida, the most frequent visitors observed on the plants near Boca Raton, Palm Beach County, are *Apis mellifera.* There is a marked behavioral division among the Honey Bee individuals visiting the plants.

Most of the Honey Bees visiting the flowers approach in the "normal" bee fashion described by Meeuse (1961) and Fagri & Pijl (1966). Instead of landing on the stamens and stigmas as they should, however, they circle around the flower and land on the outside of the calyx and corolla (Figs. 1-4). After landing they separate two petals with their front legs, insert their tongues, and sip nectar (Fig. 3). They continue this procedure around the flower until they have collected nectar between all the petals. Once a flower has been utilized, the bees fly to another and repeat the process. Several flowers are usually visited before the bee disappears.

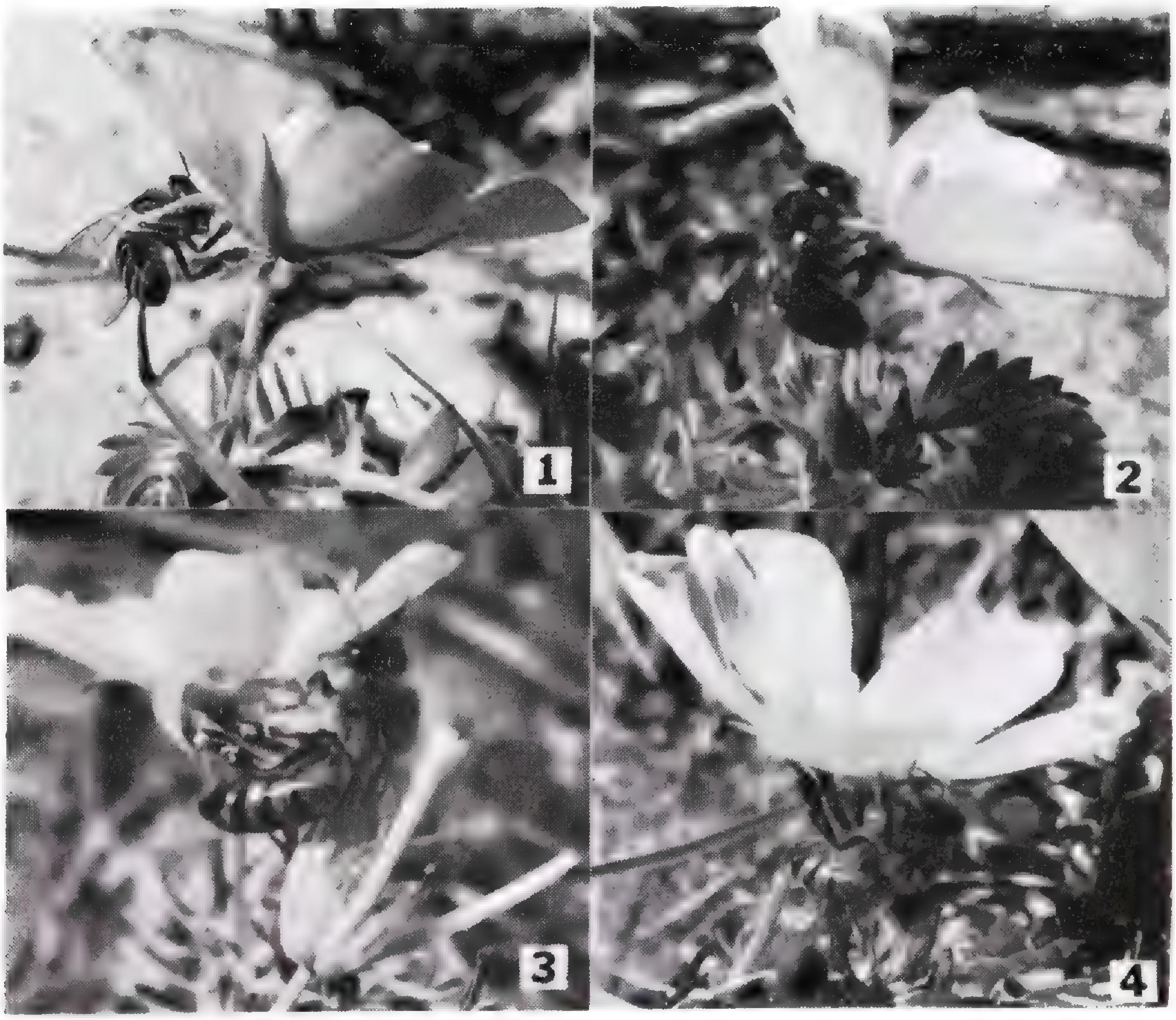

Figure 1-4. *Apis mellifera* visiting the flowers of *Tribulus cistoides* from the back. Note the tongue of the bee in Fig. 3.

Other Honey Bees approach and land within the corolla in the "normal" manner. In so doing they position their bodies over the stigma and stamens (Figs. 5-7). Normally they insert their tongue between the petals and the nectary (Fig. 7), sip nectar, and turn around the flower to drink nectar from other nectaries. They dust much of their body with pollen as they turn (Figs. 5-6). After the nectar has been collected, they often brush the stamens with their front legs to gather pollen.

After nectar has been taken and pollen gathered with the front legs, the bees may fly to another flower to repeat the process. It is common, however, for an individual to brush pollen, fly off and hover in front of the flower, return to brush more pollen, and hover again. This may be done three or four times before the process is repeated at another flower.

Figure 5-8. Bees visiting the flowers of *Tribulus cistoides* from the front. Fig. 5-7. *Apis mellifera.* Fig. 8. *Chloralictus.*

Those individuals which exhibit this hovering behavior usually have their pollen baskets full. The bees with pollen in the pollen baskets have little or no pollen adhering to the hairs of their legs and body. Bees which have no pollen in their baskets rarely hover, and their bodies and legs usually are dusted with pollen. The individuals illustrated here (Figs. 5-7) were photographed between 3:40 and 4:40 p.m. in December. Although their bodies are dusted with pollen, the pollen baskets are empty.

There has been a seasonal shift in the labor of the individuals visiting the plants. From September until December about 18 out of 20 Honey Bees gathered nectar. None of the nectar gathering bees were ever seen collecting pollen. In February the visitation had dropped from about 20 bees to about 4 bees per hour. All of those bees seen in February were gathering pollen.

Associated with the reduction of visits by Honey Bees was an increase of visits by other insects. During February the flowers were visited by five bee species, three Diptera, one Hemiptera, and one Lepidoptera in addition to the Honey Bees. Equivalent observations in December revealed visits by Honey Bees with one other bee species (*Chloralictus* — Fig. 8), two Diptera, and one Lepidoptera. Honey Bees were most common in December; other bees (*Agapostemon, Chloralictus* (2 species), *Halictus,* and *Lasioglossum*) in February.

The reason for the apparent preference for *Tribulus* nectar over pollen during the period from September to December is not clear. Nor is it clear that these observations are the result of a rigid division of labor. There must be some strong force (attractant?) which guides the Honey Bees around the visual guides usually followed in flowers.

Since much of the underside of some Honey Bees is dusted with pollen, self- or cross-pollination could easily be accomplished. The plants have not been tested for autogamy or self-compatibility, but the ample fruits present suggest that Honey Bees or other visitors may successfully complete pollination. Porter (pers. comm.) indicates that *T. cistoides* is protandrous and thus probably outcrossing. Self-compatibility, however, should not be ruled out until demonstrated.

Tribulus cistoides is native to tropical and subtropical Africa (north to Cape Verde on the west and Mozambique on the east). Since it is now widely dispersed throughout the drier tropics, it often becomes a bothersome weed. *Apis mellifera,* probably native to the Mediterranean area, is also naturalized in the New World. The interactions between *Apis* and *Tribulus* in Florida probably did not evolve as the result of foraging activities of the Honey Bee in the Old World since 1) *Apis* is polytropic by nature, and 2) their distributions do not permit a long history of coevolution. It must have been only recently that *Apis* learned to utilize *Tribulus* as a nectar and pollen source, especially since *Apis* is capable of rapid learning (Meeuse, 1961;

Adams, pers. comm., 1971). Regardless of where and when *Apis* learned, pollen is frequently transported from one *Tribulus* flower to the other by the visits of *Apis*.

An important factor in the reproduction of the plants is the approach used by the *Apis* individuals. Those bees approaching from the back of the flowers merely "steal" nectar without transferring pollen, while those workers entering the flowers from the front effect pollination.

The majority of species other than *Apis* visit the flowers of *Tribulus* in the "normal" front approach. Deviations from this are the one Lepidoptera (*Melachroia*) which took nectar from the back of the flower, and occasional individuals of the Dance Fly (Diptera: Empididae) species. Most of the Dance Flies utilized the flowers in the normally expected front approach. The flies are too small, however, to accomplish much pollination.

The largest visitor observed on the flowers was a Diptera, probably a Syrphid fly, but no collection was made. Several flowers were visited by the fly before attempts at photography frightened it away. Another fly, a Tachinid Fly, has been seen occasionally throughout the period of observation. This species is commonly prey to yellow predatory spiders in the flowers.

Hymenoptera other than *Apis* have been seen on the flowers. One, a small *Chloralictus* bee, crawled under the stamens and stigma (Fig. 8). Although the individual in the photograph was not captured, others with the same behavior have been collected. These small insects moved among the stamens as they went from nectary to nectary. Due to the visits among the stamen their bodies often became heavily dusted with pollen (Fig. 8). In spite of this none of them has been seen in contact with the stigma; pollination by these small bees must be rare. An Ash-Gray Leaf Bug (Hemiptera: Piesmatidae) exhibited much the same behavior as the small *Chloralictus* bee.

Four bee species other than *Apis* are probably effective in the pollination of *Tribulus*. *Agapostemon*, *Chloralictus nymphaerum*, *Halictus*, and *Lasioglossum* all collect pollen

and nectar in the "normal" manner, and the undersides of their bodies are heavily dusted with pollen. A fifth species was observed on the plants, but not captured. This large wasp-like Hymenoptera visited the plants near Boynton Beach and gathered only nectar on the single visit observed.

PLANT COLLECTIONS: FLORIDA: PALM BEACH COUNTY: hammock end north of public beach in Boynton Beach, *Austin* 4395 (FAU); campus of Florida Atlantic University, *Austin* 4422 (FAU, MO).

INSECT COLLECTIONS: HEMIPTERA: PIESMATIDAE: *Austin* 4422-15, 4422-16 (FAU). LEPIDOPTERA: GEOMETRIDAE: *Melanchroia cephise* (Cramer), *Austin* 4422-24 (FAU). DIPTERA: EMPIDIDAE: *Austin* 4422-13, 4422-14 (FAU); TACHINIDAE: *Austin* 4422-27 (FAU). HYMENOPTERA: APIDAE: *Apis mellifera L.*, *Austin* 4422-1, 4422-2, 4422-3, 4422-17, 4422-18, 4422-19, 4422-20 (FAU); HALICTIDAE: *Agapostemon splendens* Lef.. *Austin* 4422-21 (FAU); *Chloralictus nymphaerum* Robertson, *Austin* 4422-5, 4422-23 (FAU); *Chloralictus* aff. *marinus* Crawf., *Austin* 4422-26 (FAU); *Halictus* sp., *Austin* 4422-4, 4422-28 (FAU); *Lasioglossum* sp., *Austin* 4422-6, 4422-23 (FAU).

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HERBARIUM
DEPARTMENT OF BIOLOGICAL SCIENCES
FLORIDA ATLANTIC UNIVERSITY
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REDEFINITION OF CEDRELA OAXACENSIS C. DC. & ROSE

C. EARLE SMITH, JR.

During the course of preparation of "A Revision of Cedrela (Meliaceae)" (Fieldiana: Bot. **29**: 295-341. 1960) difficulties in defining inadequate collections of Spanish cedar from Mexico and Central America led me to place many species in synonymy. Among these, I recognized a grouping of specimens with (for the genus) exceptionally large capsules under the name *Cedrela oaxacensis* C. DC. & Rose. Subsequently, Dr. Faustino Miranda kindly showed me his well-collected specimens with very good notes which indicated that the ecological disparity among the large-capsuled cedrelas was, indeed, solidly based on the confusion of at least two species. A large-fruited species in higher elevations from Chiapas to Panama bears several capsules in a hanging inflorescence. Another species, bearing single erect capsules, grows in less well watered habitats primarily in the semi-deciduous Pacific slope forests from Mexico southward. In Flora of Panama, VI. Family 92, Meliaceae (Ann. Mo. Bot. Gard. **52**: 60 seq. 1965), I partially untangled this skein of my own making by recognizing *C. tonduzii* C. DC. as the upland, moist-forest species with large capsules in hanging inflorescences. I included in this *C. salvadorensis* Standl. and I have no evidence at the present time which leads me to change this opinion.

At the time that I visited the type locality of *C. oaxacensis* (Monte Alban, Oaxaca) in 1957 in search of material identifiable with Pringle's collection 4802, the arborescent vegetation was only beginning to recover from a severe clearing which had accompanied archaeological work at this important pre-Conquest site. Unable to find *Cedrela* in the area to corroborate the original collection, I mistakenly concluded that the capsules accompanying the Pringle collection were anomalous. I have since made three collections of *Cedrela oaxacensis* in the Oaxaca Valley (one at Monte Alban in

sprout clumps from original stumps on the site) which prove that the foliage and capsules of *Pringle* 4802 are indeed related. I am now redefining *C. oaxacensis* to exclude all of the large-capsuled collections which I had previously placed there.

Cedrela oaxacensis C. DC. & Rose. Contrib. U. S. Nat. Herb. 5: 190. 1899.

Lectotype collection: *C. G. Pringle* 4802. Monte Alban, Oaxaca. Aug., 1894. (US, B, F, MO, NY, PH).

C. discolor Blake. Proc. Biol. Soc. Wash. 33: 108. 1920. Type collection: *Palmer* 184. San Ramon, Durango. Tree to 10 m tall. Branchlets thick, lenticels small, scattered. Leaves with, usually, 7 pairs of leaflets to 19 cm long, 7 cm wide, ovate, base rounded to obtuse to abruptly truncate, rarely slightly acute, apex shortly acuminate, acute, blade markedly pubescent beneath; rachis and petiolules frequently pubescent, petiolules 4 mm long or less. Inflorescence moderately open, to ca. 25 cm long in flower, to ca. 30 cm long in fruit, shorter than the leaves, puberulent; bracts early deciduous; flowers pinkish, calyx to 2.5 mm deep, 5-lobed, lobes to 1.75 mm wide at base, puberulent, petals 5.0 to 6.0 mm long, lanate without, puberulent within, pinkish, but fading toward the thinner margins; filaments fleshy, broad at point of attachment and tapering gradually upward to the anther, connective broad, apiculum short, obtuse; anthers ca. 1.0 mm long; ovary ovoid, glabrous, style to 2.0 mm long, thick, tapering very gradually to the thick, capitate stigma. Fruit 3.5 to 4.0 cm long, valves thin, less than 1.0 mm thick, outer surface lenticellate, outer layer peeling away from the inner as the capsule opens; central column with wings extending only to the margin of a distinct rostrum 6.0 to 8.0 mm in diameter, the scars from the seed attachments 5.0 to 8.0 mm long immediately beneath the rostrum between the wings.

Trees of hillslopes in the Oaxaca Valley, north and west as far as Durango and probably to the southeast along the Pacific slopes.

Isotype collections of *Pringle* 4802 and *Palmer* 184 were recently reexamined in the U. S. National Herbarium, confirming their conspecificity. Unfortunately, other material was not then available and I was unable to place other collections previously cited as *C. oaxacensis*. However, I have made the following collections in Oaxaca: Rd. to Guelatao ca. 5 km above intersection with Pan American Highway. Stream margin. *Smith & Schoenwetter* 4346. Aug. 6, 1966.; Monte Alban, on side of mound. *Smith & Kitchen* 4823. July 2, 1968.; Barranca above molino. San Gabriel Etla. *Smith & S. Kitchen* 4825. July 4, 1968.

I leave unresolved the disposition of *C. saxatilis* Rose and *C. poblensis* Miranda. I have already indicated my previous placement of *C. salvadorensis* Standl. with *C. tonduzii*. I believe that Miranda felt that *C. poblensis* is a synonym of *C. salvadorensis* (annotations on specimens in U. S. National Herbarium). Neither the specimens nor the localities clearly indicate the proper place of this species. Collections made on the Pacific slope are more apt to be the short tree with the single capsules. However, with increase in elevation, many areas support humid forests in which the larger, multi-capsuled species might be found. Additional field collecting with careful documentation is needed to delimit the ranges of the large-capsuled species. I was unable to see a specimen of *Pringle* 11806 (type collection of *C. saxatilis*) and I make no disposition, although I suspect that it belongs with *C. oaxacensis*.

I thank the staff of the U. S. National Herbarium for their generous cooperation and my colleague, Joab Thomas, for his patience and helpful comments.

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AN ABNORMAL SPECIMEN OF LAMINARIA DIGITATA (L.) LAMOUROUX

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AND RICHARD A. FRALICK[1]

The present report describes the occurrence and morphology of an abnormal specimen of *Laminaria digitata* (L.) Lamouroux. The plant was found (by Emery Swan) detached in a deep tide pool near mean low water at Odiornes Point, Rye, New Hampshire, U.S.A. (70°42′42″ W longitude, 43°03′33″ N latitude) on May 16, 1971. Figures 1 and 2 illustrate the general morphology of the plant; a single stipe and two attached blades are evident. The overall length of the plant was 208 cm. The maximum dimensions of the fronds were 120 × 98 and 76 × 74 cm respectively, exclusive of the stipe. The larger blade was darker in color, healthier in appearance, and it seemed to be more actively growing, as evidenced by its segmentation (Fig. 2), than the smaller frond.

Laminaria digitata is a common plant in the vicinity of Odiornes Point. It grows abundantly on solid rocks from 0 to 14 m below mean low water, with maximum biomass occurring from -2 to 10 m (Mathieson, Hehre and Reynolds, in press). It is speculated that the plant broke off its holdfast and then regenerated a second frond.

Recent studies by Markham (1968) demonstrated extensive regenerative capacities in *Laminaria sinclairii* (Harvey) Farlow, Anderson *et* Eaton. Detached portions of its haptera, as short as 2.5 mm in length, were capable of developing into entire plants. *Laminaria digitata* also exhibits extensive regenerative capacities (unpublished data, A. Mathieson), for new blades can be produced from intact stipes if they are injured or destroyed. Similar regenerative capacities are probably evident in healthy, pelagic specimens. Figure 3 shows a conspicuous swelling of the

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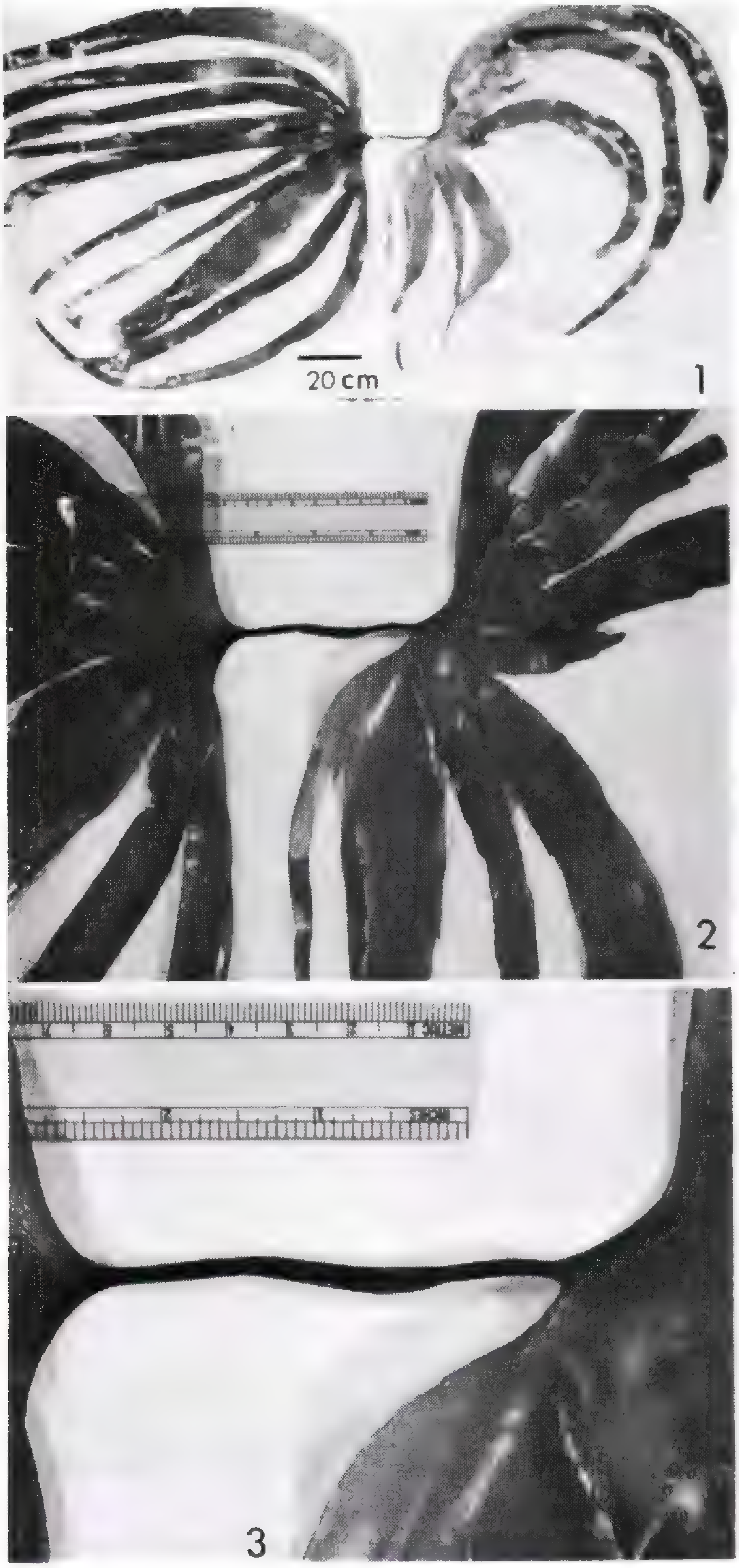
20 cm
1
2
3

stipe in the abnormal specimen; it probably represents the site of regeneration of the second frond. The swelling is several cm below the transition zone — the area of "active" cell division. Thus, regeneration occurred in an area presumably restricted to elongation and differentiation of cells. The older appearance of the smaller frond suggests that it is the original one. However, in order to preserve the intact specimen a critical examination (section) of the stipe was not made.

Burrows (1956, 1958) reported extensive populations of loose-lying algae (particularly *Chorda filum, Desmarestia aculeata, Laminaria saccharina* and *Saccorhiza polyschides*) from the subtidal zones at Port Erin Bay, Isle of Man — particularly after periods of calm weather and high insolation. Most of the plants were initially attached. Extensive SCUBA observations near Odiornes Point have never shown quantities of loose-lying *L. digitata* or any other algae — perhaps because of the exposed nature of the site. The accidental deposition of the specimen in a deep tide pool may have provided a relatively stable habitat and allowed regeneration to occur. According to Burrows (1958) members of the loose-lying populations may serve as a means of restocking habitats devoid of reproductive plants. No reproductive sori were found on the specimen of *L. digitata.* The vegetative stae of the plant may have been due to the time of its collection, for *L. digitata* exhibits limited reproduction during the spring in New England (Mathieson, Hehre and Reynolds, in press). It should also be noted that several pelagic algae (e.g. *Sargassum, Focus* and *Gracilaria*) are reported (Fritsch, 1959) to have limited reproductive capacities.

Figure 1. Intact specimen of *Laminaria digitata,* with a single stipe and two attached blades.

Figure 2. Close up of stipe and fronds, showing darker and healthier appearance of larger (left) frond. Active segmentation of the larger frond is also visible.

Figure 3. Conspicuous swelling of the stipe, that may represent the site of regeneration of the second frond.

According to van Overbeek (1940 a, b) auxins may be found in *Macrocystis pyrifera* and other known brown algae. If this were true for *L. digitata*, then the loss of polarity, due to a pelagic state, may explain the regeneration of a second frond rather than a holdfast. Extensive regeneration and the loss of polarity must also occur in other unattached algae that produce spherical morphologies, such as *Cladophora holsatica* Kützing described by Smith (1950) and the "beach form" of *Ascophyllum nodosum* (L.) Le Jolis ecad *Mackaii* (Turner) Cotton reported by Gibb (1957).

In conclusion the occurrence of an abnormal specimen of *L. digitata* poses a variety of questions concerning the growth and ecology of the species. Additional studies should be carried out to determine the growth, reproduction and ecological significance of pelagic specimens of *L. digitata.*

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RANGE EXTENSIONS OF VASCULAR AQUATIC PLANTS IN NEW ENGLAND

C. Barre Hellquist

During 1970 and 1971 extensive collecting of vascular aquatic plants was conducted in New England. New records for some states as well as interesting extensions of range were noted. In New England the aquatic flora has been neglected during the past twenty years, so these ranges may have expanded or may have been overlooked. Such botanists as M. L. Fernald and A. S. Pease did extensive collecting in the time span of 1920 to 1955. Since then no single person has devoted much time to the aquatics in New England except William Countryman who has done extensive collecting in Vermont.

The plants collected and observed are discussed below. Representative specimens have been deposited in the author's personal herbarium as well as those of Boston State College, the University of New Hampshire and the New England Botanical Club.

Potamogeton filiformis Pers. var. **borealis** (Raf.) St. John

Both *Potamogeton filiformis* and its variety *borealis* are found in New England only in the extreme north. A plant of calcareous waters, (St. John, 1916), this plant has been collected from several areas in Aroostook County, Maine, and in northern Vermont (Seymour, 1969). A specimen in the University of New Hampshire herbarium (*S B. Krochmal*, 142a) from Piermont, New Hampshire, Grafton County was examined by this author and keyed out as *P. filiformis* Pers. var. *Macounii* Morong, which has never been reported from New England. This identification is questionable and more specimens of this plant would be desirable for absolute identification. In October 1970, several specimens of the variety *borealis* were collected for the first time in New Hampshire in Lombard Pond, Colebrook, Cöos County (*Hellquist* 93 and 94). This pond has

the highest alkalinity of any in the state with a Methyl Orange ppm. reading of 90 (Newell, 1960). Of all the ponds in New Hampshire this is one of the few where this *Potamogeton* would find the requirements of an alkaline body of water in the northern portion of the state. Lime Pond in Colebrook and Ladd Pond in West Stewartstown might also harbor this species.

Potamogeton crispus L.

This has increased its range extensively in the past fifty years. Records in the Gray Herbarium and the New England Botanical Club Herbarium include very few reports of the species. Seymour (1969) noted this plant from Middlesex County in Massachusetts, Chittenden County in Vermont, Providence County in Rhode Island and a number of areas in Connecticut. Collections of this plant were made from a number of ponds and lakes in Massachusetts and a couple from northwestern Connecticut. Ogden (1943) noted it from Spy Pond in Arlington, Massachusetts, Fresh Pond in Cambridge, Massachusetts and the Sudbury River in Concord, Massachusetts. All of these are in Middlesex County. In Connecticut, the Housatonic River in Litchfield County was the only area noted.

From the recent collections by the present author it is evident that *Potamogeton crispus* L. has increased its range extensively, especially in the hard water regions of Berkshire County, Massachusetts. This plant was extremely common in the Stockbridge Bowl, Stockbridge, Massachusetts where it was the most abundant pondweed and along with *Myriophyllum spicatum* L. var. *exalbescens* (Fernald) Jepson made up about 80% of the vascular vegetation. This plant was also extremely common at Lake Buel in Monterey and New Marlboro, Massachusetts, Mill Pond, South Egremont, Massachusetts and the Mill Pond in Sheffield, Massachusetts. A new record in Middlesex County for this species is Fisk Pond, Framingham, Massachusetts. From Connecticut it was found in Mudge Pond and Indian Lake, Sharon, Litchfield County. In all the above mentioned

areas except Stockbridge Bowl it was not the predominant species but was nevertheless common. This species has been known to be more tolerant of polluted waters (Fassett, 1966). After observing the water where collections were made this statement would seem to hold true. The ponds from western Massachusetts and Connecticut were in alkaline regions where this plant does well (Moyle, 1945). This plant should be looked for in almost all hard water regions of New England especially where pollution may occur.

Potamogeton strictifolius Ar. Benn. Var. **rutiloides** Fern.

This is one of the narrow-leaved pondweeds of the section Pusilli and is characteristic of basic or alkaline waters of the northern United States and Canada (Fernald, 1932). Fernald at that time noted it from Lake Champlain, Vermont. Seymour (1963) recorded the variety *rutiloides* from three other areas of western Vermont not far from Lake Champlain as well as from Berkshire County, Massachusetts.

A new eastern record for *Potamogeton strictifolius* Ar. Benn. Var. *rutiloides* Fern. in New England is the Mill Pond in Windsor, Vermont, Windsor County. It was abundant in some of the shallow areas on the eastern side of the pond. This plant, upon first observation, was mistaken by the writer for *Potamogeton Friesii* Rupr. with which it may be confused easily. *Potamogeton strictifolius* and its variety generally have three veins, but this specimen had three to five. Fernald (1932) noted that *P. strictifolius* may rarely have five veins. The Mill Pond has the typical vegetation of the more alkaline lakes including *Najas flexilis* (Willd.) Rostk. & Schmidt., *Vallisneria americana* Michx. and *Potamogeton pectinatus* L. (Moyle, 1945).

Potamogeton longiligulatus Fern.

One of the rarer pondweeds in the United States as well as New England is *P. longiligulatus*. Only two specimens have been reported and both were from northwestern Connecticut. Fernald (1932) noted it from Twin Lakes, Salis-

bury, Connecticut, where it was collected by C. H. Bissell in 1906. A second report was from Indian Lake in Sharon, Connecticut, (Seymour, 1969). This specimen was deposited in the New England Botanical Club Herbarium but after careful study by the writer it was found to be a very narrow-leaved form of *Potamogeton zosteriformis* Fernald.

The second actual record for this specimen comes from Evarts' Pond (Lake Runnymede) in Windsor, Vermont, Windsor County. Evarts' Pond is a privately owned pond which is of interest in that it was one of the ponds where *Potamogeton Hillii* Morong. had been reported in 1875 (Fernald, 1932). More recent collections of P. Hillii from Evarts' Pond in the late thirties are in the New England Botanical Club Herbarium. In an attempt to find *Potamogeton Hillii,* permission was received from the owners to collect in the pond.

A narrow-leaved pondweed believed to be *Potamogeton Hillii* was collected by the author at the northern portion of the northeast bay and on the southwestern end of the pond. In both areas it was found in water approximately three feet deep. Upon examining these collections carefully, it was determined that the two rare Potamogetons, *Hillii* and *longiligulatus* were both found. Fernald (1932) commented on much confusion in identifying these two species. Both have sharply acute, cuspidate leaves. *Potamogeton Hillii* has three veins while *P. longiligulatus* has five to nine. Both specimens were in flower at this time so they had the same initial appearance.

In talking with Mr. Evarts, one of the owners, it was learned that the state of the pond had deteriorated over the past two summers. The water previously had been very clear, but now becomes cloudy as the water warms up in the summer. He stated that corn has been planted along the north side of the pond, and is fertilized extensively with chemicals. This most likely has led to the turbid water with its poor light penetration so it was rocommended that the corn crop be discontinued in 1972. Hopefully this would clear up the problem. Since this pond has no inlets, but

is spring-fed, it shouldn't take long for the water to become clear again. It would be a shame for the ecology of this pond to be so disturbed that these two valuable pondweeds would be destroyed. *Nymphaea tuberosa* Paine was also discovered here and will be discussed later in this paper.

Potamogeton gemmiparus Robbins.

This uncommon narrow-leaved pondweed has been reported from only four New England states: Maine, Massachusetts, Connecticut and Rhode Island (Fernald, 1932). Since it is from eastern New England it is found in more acid waters. This plant had never been reported in New Hampshire, where it should occur. Seymour (1969) records it as near as Fryeburg, Maine, where it is found in the Saco River.

Two stations of this plant were found by the author in Carroll County, New Hampshire, both in the Saco River drainage. One station where it was somewhat rare was the southern end of Conway Lake in Eaton, New Hampshire. Here it was found with other acid water plants such as *Potamogeton Berchtoldii* Fieber, *P. Berchtoldii* Fieber, var. *tenuissimus* (Mert. & Koch) Fern., *P. epihydrus* Raf. var. *ramosus* (Peck) House, *P. gramineus* L. var. *gramineus* and *P. capillaceus*. Bearcamp Pond in Sandwich, New Hampshire was the other site of collection. Here the specimen was collected at the inlet of the Bearcamp River. Again, it was not plentiful. *Potamogeton gemmiparus* was growing along with *P. natans* L., *P. gramineus* L. var. *myriophyllus* Robbins., *P. gramineus* L. var. *gramineus*, *P. confervoides*, Reichenb., *P. capillaceus* Poir. and *P. Spirillus* Tuckerm.

Egeria densa Planchon

Egeria has been reported from three different towns in New England — two in Massachusetts and one in Vermont (Seymour, 1969). The reports from Massachusetts were from Abington in Plymouth County and Quincy in Norfolk County. In Vermont it was collected from Townshend, Windham County. It was observed by the writer to be very

common in Hemenway Pond, Milton, Massachusetts, Norfolk County, near the Boston city limits where it was growing with *Elodea Nuttallii* (Planch.) St. John, *Potamogeton epihydrus* Raf. var. *ramosus* (Peck) House, *Myriophyllum humile* (raf.) Morong and *Utricularia geminiscapa* Benj. This plant was introduced and naturalized from South America and is one to be looked for around cities because it is being sold in pet shops.

Wolffia columbiana Karst.

This plant is continuing to spread its range to the north in New Hampshire. Previously reported from Hillsborough County, (Countryman, 1968) and Rockingham County (Colt, *et. al.*, 1971) it was discovered by the author in Durham, New Hampshire, Strafford County. In Durham, it was reported from two new locations — the Mill Pond and Beard's Creek Pond. This plant was not observed in either place in 1970, but was very abundant at Beard's Creek Pond and common at the Mill Pond in 1971. *Wolffia punctata* Griseb., which usually occurs with the former, was not found but should be looked for in the future.

In talking with Dr. Albion Hodgdon at the University of New Hampshire in Durham, it was agreed that this plant probably is rapidly extending its range. One explanation for the rapid spread may be the passage of ducks in the region moving between ponds. *Wolffia* would stick to their bodies and be carried around easily. Also anyone transferring a boat from ponds could easily introduce the plants into new bodies of water.

Nymphaea tuberosa Paine

Seymour (1969) recorded this plant from six stations in western Vermont, Winchester, Massachusetts, and three townships in Connecticut. This species has been found by the writer to be quite abundant. In Vermont, a new eastern record for the state is herein reported from Evarts' Pond, Windsor County. Here it was the only member of the Nymphaeaceae and was found extensively around the pond. The first two records for this plant in New Hampshire are

Lake Kanasatka, Moultonboro, Carroll County and Beard's Creek Pond, Durham, Strafford County. This pond lily was found at the southern end of Lake Kanasatka near the gift shop "The Horse of Another Color" along Route 25. It appears that this plant was introduced here some time ago, due to its localized range at the southern end of the lake. It was found with other members of the same family including *Nymphaea odorata* Ait., *Nuphar variegatum* Engelm., and *Brasenia Schreberi* Gmel. This is a lake with a higher alkalinity than most other lakes in Carroll County as shown by the presence of *Potamogeton zosteriformis* Fernald and *P. praelongus* Wulfen. At Beard's Creek in Durham *Nymphaea tuberosa* Paine was found near Route 4 where it has spread throughout the southern end of the pond. The water is probably in much the same condition as Taylor River in Hampton, New Hampshire (Colt, *et al.,* 1971) since this also is a tidal estuary which has been blocked off by a dam. Much salt in the bottom might tend to raise the alkalinity of the water. Other plants of interest growing along with *N. tuberosa* here are *Myriophyllum verticillatum* L. var. *pectinatum* Wallr. and *Elodea Nuttallii* (Planch.).

In Massachusetts this plant was discovered by the writer in three locations, all within Middlesex County. These were the Sudbury and Concord Rivers in Concord, Massachusetts and a small pond by Upper Mystic Lake in Winchester, Massachusetts which is near the previously reported site. Mr. Richard Eaton of Lincoln, Massachusetts told the author in 1971 that *Nymphaea odorata* used to be very common in these rivers and was almost completely destroyed due to the pollution. *Nymphaea tuberosa* is found in the highly productive lakes of the midwest and seems to be more tolerant of polluted waters. In the Sudbury River *Nymphaea odorata* was found in limited numbers while *N. tuberosa* was more common. The area observed in the Concord River had *Nymphaea tuberosa* as the only water lily and it was found at only one location.

The location at Winchester, Massachusetts was a small

pond at the recreation area on the east side of Upper Mystic Lake. It appears that this lily was planted here as it does not extend into Upper Mystic Lake which connects with this pond.

This plant may be more common than previously observed. Many of the specimens reported as *Nymphaea odorata* Ait. var. *gigantea* Tricker may actually be *N. tuberosa*. The leaves of *N. tuberosa* are generally larger and green underneath, or with only a slight purplish tinge. Probably the best identifying characteristic of this plant is the large green petiole with brown stripes as opposed to the purple petiole of *Nymphaea odorata*. Fernald (1950) noted that the flowers are odorless or barely fragrant which may be misleading. The flowers have a noticeable odor, but when compared with *N. odorata* they are less fragrant. Another interesting feature found on a number of specimens was the presence of pubescence on the petiole near the blade. In some this was so marked that the striping in the petiole was obscured. Other characteristics which aid in identification are the more rounded petals and the tendency of the leaves to become elevated above the water by as much as one foot.

Nymphaea alba L. forma **rosea** Hartm.

A European species, this pond lily has not been reported previously from New England. It was found by the writer to be relatively abundant in Winkley Pond, Barrington, New Hampshire, Strafford County. It occurs around the perimeter of the Pond where it grows with *Nymphaea odorata* and a possible hybrid between *N. odorata* and *N. alba* f. *rosea* which has the pointed more numerous petals and is a light pink. Winkley Pond is an acid body of water in a semi-bog condition with many ericaceous plants. Of particular interest as an associated plant is *Potamogeton confervoides* Reichenb. which is extremely common there.

Nymphaea alba f. *rosea* is characterized by 12-24 rounded deep pink petals (Fernald, 1950). The leaves are similar to *N. odorata* with deep purple undersides. The following

observations were made on *N. alba* f. *rosea:* many of the petioles were pubescent as seen in *N. tuberosa* and the leaves were elevated above the surface of the water along the edge of the pond. Because of the attractive blossom, this water lily may have been planted more extensively than observed. Many specimens labeled *Nymphaea odorata* Ait. forma *rubra* Guillon may actually be *N. alba* f. *rosea.*

Myriophyllum alterniflorum D. C.

Except for the present report *M. alterniflorum* has been found in New England only from numerous areas in Vermont and Maine and from Cöos County in northern New Hampshire (Seymour, 1969). Last year the first record of the species south of Cöos County in New Hampshire was noted in Upper Danforth Pond, town of Freedom, Carroll County, (Hellquist, 1971). Two other locations for this plant have also been found in Carroll County by the writer. One is from Cooks Pond in Madison, New Hampshire where it was scarce. Isolated plants were found in this acid-water pond which also included *Potamogeton confervoides* Reichenb. (Hodgdon, *et. al.,* 1946). Lake Kanasatka, Moultonboro, New Hampshire was the other station. The *Myriophyllum* was found at the south end of the lake near the previously reported *Nymphaea tuberosa* Paine. As more extensive studies are carried out in central New Hampshire, this plant should prove to be more abundant.

Myriophyllum heterophyllum Michx.

This plant has been quite uncommon in New England until recently if the few herbarium specimens are a fair indication. It had been recorded from Bridgeport, Connecticut, Uxbridge and Sutton, Massachusetts (Seymour, 1969). A specimen from Sandy Pond, Ayer, Massachusetts, collected by Edward Richardson in 1940 is on deposit in the University of Massachusetts herbarium.

In southern Worcester and Middlesex Counties, Massachusetts, the writer found *M. heterophyllum* to be extremely common in a number of ponds and lakes, where it forms

large beds around the shore. It has been found in Whitehall Reservoir and North Pond in Hopkinton, Middlesex County; Pratt Pond, Upton; Silver Lake, Grafton; and Hopedale Pond, Hopedale, Worcester County. Houghton's Pond (Hoosiwhisick Pond), Canton, Norfolk County, Mill Pond, Wareham, and Agawam River, Wareham, Plymouth County are other areas where this plant was found to be abundant. Fassett (1966) noted this plant to range from Virginia to Florida, west to Ontario and Minnesota, so it appears that this specimen is spreading rapidly in southern New England. One cause of this recent and rapid spread may be the fact that the plant is sold extensively in pet shops for aquarium use. It may be discarded into ponds and streams as has *Egeria densa* Planchon.

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A SECOND OCCURRENCE FOR TRIPHORA TRIANTHOPHORA (SW.) RYDB. IN MAINE. Another station of the orchid, *Triphora trianthophora*, the second to be found in the last few years, was discovered on August 31, 1971 at Evans Notch, Batchelders Grant, Oxford County by C. Paul Wight and me. This location is about three miles in a direct line from the Stow station (Rhodora 71: 509, 1969). This new station consists of many individuals growing on a wooded hillside in depressions which are filled with thickly matted beech leaves. It is difficult to estimate how many of the orchids occur at this station, as they tend to grow singly, spreading out over a large area, unlike the Stow station, where the orchids were growing in large groupings. We were fortunate in finding many of the plants still in flower for the majority had already lost their blossoms. Other interesting plants were found among the Triphoras, namely, *Corallorhiza maculata, Conopholis americana, Epifagus virginiana,* and members of the *Botrychium* group.

Specimens have been deposited at the Herbaria of the University of Maine and the New England Botanical Club.

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ILLINOIS FIELD AND HERBARIUM STUDIES

ROBERT H. MOHLENBROCK AND DAN K. EVANS

Continued field and herbarium studies of Illinois plants have resulted in the discovery of several unreported or previously undocumented taxa for the state. These new additions to the flora are reported in this paper, in addition to locality records for other rare taxa in southern Illinois. All specimens cited are in the herbarium of Southern Illinois University (SIU), unless otherwise indicated.

TAXA NEW TO ILLINOIS

Cyperus iria L., an introduced southern sedge, was known to range in North America from Virginia east to southeastern Missouri, southwest to Texas, and east to Florida. Now Illinois may be added to the range. In Illinois, this species may be found sparingly in the wet meadows at Horseshoe Lake, Alexander County.

Of the twenty-one taxa of *Cyperus* found in Illinois, this species may be most likely confused with those in the following key.

a. Scales 1.0-1.5 mm long; achenes 0.8-1.0 mm long. b.
  b. Achenes white; spikelets about 1 mm broad; scales closely arranged .... *C. erythrorhizos*
  b. Achenes brown or black; spikelets about 1.5 mm broad; scales somewhat remote from each other .... *C. iria*
a. Scales 1.5-4.5 mm long; achenes 1.0-2.8 mm long. c.
  c. Scales remote, the tip of one just reaching the base of the one above; base of the achene enclosed in a corky sheath .... *C. engelmannii*
  c. Scales approximate and overlapping; no corky sheath present at base of achene. d.
    d. Some or all of the mature spikelets reflexed; spikelets subterete .... *C. lancastriensis*
    d. None of the spikelets (except sometimes the lowest pair) reflexed; spikelets flattened. e.

e. Rhizomes scaly and usually ending in a tuber; scaletips slightly spreading .... *C. esculentus*

e. Rhizomes absent or merely hard and corm-like; scaletips appressed. f.

f. Plants annual without rhizomes; scales ferrugineous or golden-brown, 1.7-3.0 mm long; achenes obovoid-oblongoid .... *C. ferruginescens*

f. Plants perennial with hard, corm-like bases; scales stramineous, 3.5-5.0 mm long; achenes linear .... *C. strigosus*

COLLECTION DATA: Alexander County: Horseshoe Lake, wet meadows, July 30, 1968, *E. Estes* s.n.

Ulmus procera Salisb. Several specimens of the English elm occur in the vicinity of an abandoned farm along the "Giant City blacktop" about 1 1/4 miles north of Giant City State Park. The colony is apparently spreading by suckers. This elm is distinguished by its scabrous upper leaf surface and the presence of corky wings on the branches. COLLECTION DATA: Jackson County: along blacktop road between Carbondale and Giant City State Park, June 26, 1970, *R. H. Mohlenbrock* 19256.

Amaranthus caudatus L. This often cultivated Tassel Flower was collected from a spontaneous colony in waste ground. Although it has undoubtedly escaped elsewhere in Illinois, this is the first report of such an occurrence. COLLECTION DATA: Jackson County: waste ground, Oakland Street, Carbondale, July 29, 1970, *D. Evans* 1112.

Ranunculus repens L. var. **pleniflorus** Fern. The garden form of the creeping buttercup, with most of its stamens transformed into petals, was collected in a grassy area at the edge of the campus of Southern Illinois University, Carbondale. COLLECTION DATA: Jackson County: Carbondale, August 14, 1967, *R. H. Hohlenbrock* s.n.

Nigella damascena L. The Love-in-a-mist, a member of the Ranunculaceae, is occasionally grown as a flower garden ornamental and is rarely escaped from cultivation. However, a few specimens were observed at the edge of an

abandoned lot at the rear of 411 South 20 Street, Murphysboro, during the summer of 1968. The deeply divided involucre which subtends the blue flowers accounts for the common name. COLLECTION DATA: Jackson County: lot, rear of 411 S. 20 Street, Murphysboro, July 27, 1968, *R. H. Mohlenbrock* 16121.

Rorippa islandica Oeder var. **islandica.** This variety of Yellow Cress, new to the Illinois flora, was collected from mud and sand flats along the Mississippi River. In that habitat it occurs with the more abundant variety *fernaldiana* and a similar second species, *R. sessiliflora.*

Although normally found in the northeastern United States, Quebec, and Greenland, Steyermark (1960) reports a station in Harrison County, Missouri. COLLECTION DATA: Jackson County: Mississippi River mud and sand flats, Grand Tower, November 1, 1969, *D. Evans* 656.

Rubus procerus P. J. Muell., a native of Europe, is reported by Fernald (1950) as naturalized in the United States from Delaware to Virginia. Steyermark (1963) reports a Palmer collection from Newton County, Missouri. The authors collected this Illinois record from a roadside habitat in Randolph County, where it grows in abundance. The large drupelets are most edible. Among the many taxonomically difficult species of *Rubus* one encounters in Illinois, only three have leaflets with the underside whitened. These may be identified in the field by the following key:

a. Stems glaucous . . . . *R. occidentalis*

a. Stems not glaucous. b.

  b. Mature fruit red; prickles small, bristle-like or absent; leaves ovate-lanceolate . . . . *R. idaeus* var. *strigosus*

  b. Mature fruit black; prickles abundant, flat with a broad base; leaves broadly ovate . . . . . . *R. procerus*

COLLECTION DATA: Randolph County: roadside, 10 miles south of Chester, Illinois, July 21, 1970, *R. Mohlenbrock & D. Evans* 1113.

Croton texensis (Klotzsch) Muell. Jones and Fuller (1955) report that although Ferguson (1901) cites a Hall

collection of this species from Athens, Illinois, it is excluded from the Illinois flora since no specimen could be found to verify this report. However, a specimen of this species, collected by Hall from Athens, is on deposit in the herbarium of the Missouri Botanical Garden. This poisonous species normally ranges from South Dakota, south to Mexico, with introductions known from western Missouri, Alabama, and New England. COLLECTION DATA: Menard County Athens, *Hall* 514.

Hibiscus syriacus L. The Rose-of-Sharon is a small tree often planted, particularly in the past, as an ornamental. Occasionally specimens may be found around abandoned homesteads, although they generally do not appear to be spreading. A small grouping of specimens occurs along an abandoned road on the Little Grassy camp facilities of Southern Illinois University. At this site, there is indication that the plants have multiplied since their original planting some forty years ago. COLLECTION DATA: Jackson County: along dirt road, Little Grassy camp, Southern Illinois University, August 14, 1969, *R. H. Mohlenbrock* s.n.

Ascyrum hypericoides L. var. **hypericoides**. The range of the typical variety of *A. hypericoides* generally lies to the south and east of Illinois. On the other hand, var. *multicaule* (Michx.) Fern., is a relatively common taxa in dry woods, on slopes, and along ridges across the southern tip of Illinois. Variety *hypericoides* has never been reported from Illinois although there is a specimen of it, housed in the herbarium of the Missouri Botanical Garden, annotated by Dr. Preston Adams, the most recent monographer of the group. It is interesting to note, however, that Adams fails to attribute this variety to Illinois in his monograph (1957). Variety *hypericoides* differs from var. *multicaule* by its more ascending habit and by its narrower leaves which attain widths of only 4(-5) mm. COLLECTION DATA: Hancock County: Augusta, July, 1842, *S. B. Mead* s.n.

Hypericum punctatum Lam. var. **pseudomaculatum** (Bush) Fern. When a typical specimen of the Large Spotted St. Johns-wort is encountered, the first reaction is to con-

sider it a distinct species since the large flowers are so strikingly different from the similar but smaller-flowered var. *punctatum.* However, no other characters seem to exist which can reliably distinguish var. *pseudomaculatum* from var. *punctatum.* A frequently used character to separate these two entities is the uppermost leaves obtuse in var. *punctatum* and acute in var. *pseudomaculatum.* Although all specimens which we have observed of var. *pseudomaculatum* do have acute upper leaves, a few specimens of var. *punctatum* also have acute upper leaves. Jones (1963) and Jones, *et al.* (1955) attribute *Hypericum pseudomaculatum* to Illinois, but do not indicate localities. Since we have never before observed a specimen of this plant from Illinois, we are documenting its occurrence in Illinois by the following collection. COLLECTION DATA: Jackson County: dry woods, July 26, 1964, *J. Ozment & DeFilipps* 1726.

Hypericum densiflorum Pursh. This shrubby St. Johnswort previously was known from southern Missouri, but the collection cited below is apparently the first from Illinois. This species closely resembles *H. lobocarpum* from which it differs only by the presence of three styles and a 3-celled capsule. Since these seem to be fundamental differences to us, we are treating the two as separate species. Other botanists prefer to treat *H. lobocarpum* as a variety of *H. densiflorum.* Although Fernald (1950) indicates that the tip of the leaf may be used to separate *H. densiflorum* from *H. lobocarpum,* we do not find this character to be reliable. The other shrubby St. Johns-wort in Illinois with three styles is *H. spathulatum,* a species usually larger in all respects. COLLECTION DATA: Alexander County: swampy woods near Miller City, August 28, 1964, *J. Ozment & R. DeFilipps* 2712.

Hypericum sphaerocarpum Michx. var. **turgidum** (Small) Svenson. This southern variant of *H. sphaerocarpum* is recognized by its narrow, revolute leaves which have no apparent lateral nerves. In some cases, it looks more like *H. denticulatum* Walt. or *H. dolabriforme* Vent. than *H.*

sphaerocarpum var. *sphaerocarpum*. It is distinguished from *H. denticulatum* by its united styles and from *H. dolabriforme* (which does not occur in Illinois) by its shorter sepals and somewhat smaller flowers. COLLECTION DATA: Jackson County: railroad prairie, 6 miles north of Murphysboro, June 13, 1953, *R. H. Mohlenbrock* s.n.; Macoupin County: railroad prairie southwest of Carlinville, August 15, 1968, *J. White* 335; Monroe County: limestone bluffs, one mile south of Fults, August 7, 1962, *J. Ozment* s.n.

Hypericum sphaerocarpum Michx. var. **turgidum** (Small) (1945) indicated that the Northern St. Johns-wort was known from Illinois, we are unaware of any Illinois collections of this species prior to the 1964 collection cited here. Since the overall range of *H. boreale* reaches from Newfoundland across to eastern Iowa, its occurrence in northern Illinois is not unexpected. This species is similar in appearance to the other small-flowered species of *Hypericum* in Illinois, but differs in the bracteal leaves which are similar to the cauline leaves in shape and size. COLLECTION DATA: Iroquois County: Iroquois County Conservation Area, August 17, 1964, *J. Ozment & R. DeFilipps* 2298.

Aesculus glabra Willd. var. **leucodermis** Sarg. This variety differs from typical *A. glabra* in its distinctly whitened lower leaf surfaces and its whitish bark. At its only Illinois location, it grows in a mesophytic woods. COLLECTION DATA: Jackson County: along Kinkaid Creek, three miles south of Ava, July 14, 1970, *R. H. Mohlenbrock* s.n.

Acer rubrum L. f. **tomentosum** (Desf.) Dansereau. This form is enigmatic in that the densely tomentose lower leaf surface of this upland taxon is identical with that of the swamp-inhabiting *A. rubrum* L. var. *drummondii* (H. & A.) Sarg. Only the fruits can be used reliably to separate these two taxa. Forma *tomentosum* has samaras up to 2.5 cm long, while var. *drummondii* has samaras over 3.0 cm long. COLLECTION DATA: Union County: upland woods, Pine Hills, July 3, 1970, *R. H. Mohlenbrock* s.n.

Euonymus fortunei (Turcz.) Hand.-Maz. This climbing

evergreen ornamental has become rampant in a low woods in Giant City State Park. COLLECTION DATA: Jackson County: low woods, Giant City State Park, February 6, 1971, *R. H. Mohlenbrock* 21626.

Elaeagnus umbellatus Thunb. is previously unreported from Illinois. Collections from this small tree were made from an island in Lake-of-Egypt, Williamson County. At this site a large number of plants are well established and are spreading spontaneously. No evidence of a homesite exists on the island. *Elaeagnus umbellatus* differs from *E. angustifolia,* also a rare adventive in Illinois, by displaying both brown and silver scales on the leaves and twigs, while the latter has only silver scales present. COLLECTION DATA: Williamson County: island in Lake-of-Egypt, August, 1970, *J. Swayne* s.n.

Cynosciadium digitatum DC. represents a genus new to the Illinois flora. Collections of this species were made from the Pin Oak flats in the Greentree Reservoir, Jackson County. This area, long set aside as a waterfowl preserve, has seldom been botanized during the growing season since it is mostly innundated and infested with mosquitos. Collections made in 1969 and again in 1970 from widely separated areas indicate this species is well established at this southern Illinois site. Associated species include *Glyceria striata, Carex squarrosa, Quercus palustris,* and *Ptilimnium costatum.* The overall range of this species previously reached from Mississippi and Texas north to Oklahoma, and east to southeastern Missouri. COLLECTION DATA: Jackson County: Greentree Reservoir, Pin Oak flats, June 6, 1969, *R. Anderson & D. Evans* 1001.

Scutellaria ovata Hill var. **rugosa** (Wood) Fern. This taxon is very different in appearance from the other varieties of *S. ovata* (var. *ovata* and var. *versicolor*) in Illinois. Its small, rather sprawling habit is contrasted sharply with the large, erect stature of the other varieties. Perhaps the most striking difference exhibited by var. *rugosa* is found in the leaves, which are strongly wrinkled and seldom reach a length greater than 4 cm. In general, var. *rugosa*

occupies dry, rocky slopes, whereas var. *ovata* and var. *versicolor* occur more frequently in more mesic woodlands. Fernald (1950) indicates that var. *rugosa* is further distinguished by its smaller corolla (about 1 cm long). Illinois as well as Missouri material assignable to var. *rugosa* frequently has the corolla up to 1.5 cm long, while some corollas in var. *ovata* and var. *versicolor* may be less than 1.5 cm long. COLLECTION DATA: Monroe County: south of Fults, Illinois, August 14, 1952, *W. Bailey & J. Swayne* 2818.

Hypochoeris glabra L. This introduced species is not recorded in Gray's Manual of Botany, 8th edition (Fernald, 1950). The station closest to Illinois seems to be eastern South Carolina as reported by Radford, *et al.* (1964). In Illinois, this species was collected from waste ground where it grew with other pioneer-type weeds. The beakless outer achenes of *H. glabra* distinguish it from *H. radicata*, also a rare species in *Illinois*, in which all the nutlets are beaked. COLLECTION DATA: Jackson County: rear of 1401 Tripoli, Carbondale, July, 1969, *P. Thomson* s.n.

ADDITIONAL LOCALITIES FOR RARE SOUTHERN ILLINOIS TAXA

Carex hystricina Muhl. This species is relatively common in the northern two-thirds of the state, but is known elsewhere in Illinois only from Pulaski and now Union County. Union County: LaRue Swamp, June 28, 1969, *D. Tindall & S. Wunderle* s.n.

Lychnis alba Mill. This Union County collection is from the farthest south locality for this species in Illinois. Union County: along Route 51, near Cobden, May 15, 1969, *R. H. Mohlenbrock & D. Evans* s.n.

Ranunculus carolinianus DC. The achenes of this species are larger (over 3.5 mm long) than those of *R. septentrionalis* and have a conspicuous broad, high keel near the margin of the achene. Previously this species was known from collections in Champaign and Hancock counties in the central part of the state. The collection reported here is

the first for southern Illinois. Union County: McCann Springs, May, 1968, *C. Ott* s.n.

Lotus corniculatus L. This adventive is becoming increasingly more common in Illinois. There are now three southern Illinois counties for this species, as well as several northern counties. Johnson County: roadside, near Goreville, July, 1969, *D. Evans & R. H. Mohlenbrock* 1046.

Trifolium pratense L. f. **leucochraceum** Aschers. & Prantl. Only a specimen from McLean County was previously known from Illinois. Randolph County: roadside, north of Prairie de Rocher, July 21, 1970, *D. Evans* 1108.

Hibiscus trionum L. The collection reported here is the farthest south for this species in Illinois. Jackson County: mud and sand flats of the Mississippi River, Grand Tower, October 9, 1968, *D. Evans* 441.

Myriopsyllum exalbescens Fern. This species was previously known only from the northern half of Illinois. Johnson County: Lake-of-Egypt, Beaver Neck, September 6, 1968, *J. Swayne* s.n.

Lysimachia terrestris (L.) BSP. This species was not known from the southern half of the state until it was collected at the edge of a swamp. Union County: LaRue Swamp, June 25, 1968, *M. Sadler* s.n.

Verbena hastata × **urticifolia** Pepoon. This hybrid is scattered in Illinois, but its only southern Illinois localities previously had been from Hardin and Wabash Counties. Jackson County: roadside, Southern Illinois University campus, August 22, 1969, *D. Evans & R. H. Mohlenbrock* 1010.

Physalis pendula Rydb. The only previously known collection of this species is from Union County. Jackson County: mud flats of the Mississippi River, near Fountain Bluff, October 26, 1968, *D. Evans* 543.

Centaurea solstitialis L. Jackson County can now be added to Massac County for a second southern Illinois locality for this adventive. Jackson County: along Illinois Central Railroad, 1 mile S of Elkville, August 11, 1970, *D. Evans* 1091.

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CHRYSOPSIS MARIANA IN NEW ENGLAND: Until very recently, the genus *Chrysopsis* was believed to be represented in New England by the single species *C. falcata* (Pursh) Ell. It is a plant of the coastal plain ranging from southeastern Massachusetts (notably Cape Cod) to New Jersey, according to Gray's Manual, 8th edition.

Another species, the wider ranging *C. mariana* (L.) Ell. is reported from Block Island, Washington Co., Rhode Island, by Mr. Robert Marks of Attleboro, Massachusetts, and authenticated by specimens collected by him in 1969 and 1971. In a recent letter to me (November, 1971), he states that three hundred or more plants occur in an area of approximately one quarter mile on the Lewis farm in the south-west corner of the island. There appears to be a gradual decrease in abundance from near the ocean northward and eastward. Vouchers are being processed for inclusion in the herbarium of the New England Botanical Club.

It is not surprising that this species of Golden Aster should turn up on Block Island. It has been known from near-by Long Island, New York, for more than one hundred years, e.g., Hempstead, *D.C. Eaton*, 1860, (NY) Judging from specimens in the herbarium of Brooklyn Garden dated between 1886 and 1912, it seems to have been a fairly common plant in all sections of the island including the eastern end. I learn from correspondence that there is a recently collected specimen at the New York Botanical Garden from Montauk at the eastern tip (*Andrews* 3-84, 1962).

What is surprising is that such a conspicuous plant should have escaped the attention of previous visitors to Block Island, as early as ninety years ago, and especially M. L. Fernald and companions who collected extensively there in

[1]W. W. Bailey in Notes on the Flora of Block Island (Bull. Torr. Bot. Club **20**: 231-239, 1893) published a list of 294 vascular plants found by himself and his "youthful companion J. F. Collins" between July 19 and August 31, 1892. If seen by them, *C. mariana* should have been recognizable at the end of August.

August and again in September 1913.[1] It may have been present at that time, mostly in a vegetative state, having been suppressed by over-grazing by cattle, and only recently is recovering or re-capturing its former habitat among thickets of bayberry and other shrubs and stunted trees now replacing the closely-cropped turf of former pasture-land. Alternatively, Block Island may constitute a recent extension of range. I think this is unlikely. Block Island is downwind from nearby Montauk and presumably has been exposed to invasion by wind-blown seeds of *Chrysopsis* for several millenia.

However, the colony should be watched. Mr. Marks knows the island intimately and is confident that the *Chrysopsis* is localized in its southwestern corner. If it gradually spreads throughout, then recent colonization may be an attractive supposition.

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ERIOGONUM HARPERI GOODMAN IN TENNESSEE: *Eriogonum harperi* was described by George J. Goodman in 1947 (Bull. Torr. Bot. Club 74(4): 329-331). The description was based on material collected on a "marly glade" in Colbert County, Alabama (*Roland M. Harper* 3944 in 1943). Two other locations for the species, based on Harper's notes, were reported by Goodman. One was "a calcareous prairie area", also in Colbert County, and the other was "a small cedar glade" in the vicinity of Russellville in adjacent Franklin County. These three locations are within fifteen miles of each other.

Our specimens (*Rogers and Watson* 4073, August, 1970, MISSA, TENN and University of Southern Mississippi) were collected on a limestone bluff overlooking the Caney Fork River where it intersects I-40, about 7 to 8 miles east of the Carthage exit, Wilson County, Tennessee. Perhaps a half dozen plants were growing along the bluff near the highway.

This Tennessee locality is apparently the first new site to be discovered since the description of the species and the first site outside of Alabama. It extends the known range of the species approximately 150 miles to the Northeast.

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LATHYRUS APHACA L. NEW TO TENNESSEE AND THE SOUTHEAST: *Lathyrus aphaca* L. has been collected in Madison County, Tennessee, as a wild plant by the senior author. This species is a new record for Tennessee and, apparently, for the Southeast as well. Its identification was sought in all the manuals of the Eastern United States in addition to Mahler's recent monograph (1970) to no avail. The bright yellow flowers always lead to *Crotalaria* in these keys which it surely is not. Dr. Robert L. Wilbur of Duke University kindly agreed to examine a specimen, and he reports the identification to be *L. aphaca.* According to Dr. Wilbur this is the first record of the species in the Southeastern United States. Specimen cited: Tennessee. Madison County. 2.2 mi. S of Jackson on side of highway 45S. North bank. 15 June 1970. *Richard L. Beardsley,* 591. A specimen is deposited in the Memphis State University Herbarium, and others are to be distributed elsewhere. Observations in 1971 indicate that this species is persistent and may be spreading some from the original collection site. The origin of the species in Tennessee can be only speculative.

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RECORDS ON THE FLORA OF WISCONSIN: **Leonurus Marrubiastrum** L. (Labiatae), a weedy adventive from Europe, is reported to range from Pennsylvania and Delaware to Florida and Illinois. This is to announce an extension of its range into southern Wisconsin: Dane County, waste places in Kegonsa State Park, section 18, R11E, T6N, Pleasant Springs Township, *Hansen* 164, 27 September 1970. One sheet is deposited in the herbarium, Wisconsin State University-Oshkosh; no duplicates were collected. Dr. Hugh Iltis has kindly confirmed the identification; there are no Wisconsin records for the plant at WIS, MIL, or UWM. R. C. Koeppen (1957. Preliminary Reports on the Flora of Wisconsin. No. 41. Labiatae — Mint Family. Trans. Wis. Acad. Sci., Arts and Letters. **46**: 115-140) does not report the plant for Wisconsin.

Aethusa Cynapium L. (Umbelliferae), another weedy adventive from Europe, is reported by Fernald (Gray's Manual, 8th Edition, 1950) to range from Nova Scotia to southern Ontario and Minnesota, south to Delaware, Pennsylvania, and Ohio. Gleason & Cronquist (Manual of Vascular Plants, 1963) assign it a more restricted range, from Nova Scotia and Maine to Pennsylvania and Ohio. Dr. Gerald Ownbey at MIN informs me that there are indeed two Minnesota records for the plant in their collections, the latest from 1902. However, the curators at WIS, MIL, and UWM have no Wisconsin records for the plant, which can now be tentatively added to the state's flora: Winnebago County, along fence in back yard at 212 Oxford Avenue, in the city of Oshkosh; growing as a weed in a fenceline separating two vegetable gardens. The residents on either side testify that it was certainly not planted there; *Misterek* 037, 23 September 1970. Dr. Iltis has confirmed my identification; the single specimen, deposited in the herbarium here, has abundant fruits and perhaps may become more than a mere casual element in our flora.

Linaria dalmatica (L.) Mill. (Scrophulariaceae) is reported by Fernald (loc. cit.) to range from Cape Breton

Island to Pennsylvania and Ohio. This is to report its rather extensive occurrence in Wisconsin: Bayfield County, abundant and well established on a sandy roadside on county trunk J, ca. 1.5 miles N of its junction with county trunk I, section 2, R4W, T50N, Bayfield Township; *Harriman* 7124, 17 July 1971. One sheet is deposited in the herbarium here, with duplicates at UW and MIL. Iltis at UW informs me (personal communication) that there are three records for the plant from Bayfield County deposited there, plus one each from Vilas, Sawyer, Sauk, Dane, and Green counties. It is certainly to be included now in the Wisconsin flora; it was not reported by P. J. Salamun (1951. Preliminary Reports on the Flora of Wisconsin. No. 36. Scrophulariaceae. Trans. Wis. Acad. Sci., Arts and Letters. 40: 111-138).

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LOMENTARIA CLAVELLOSA (TURNER) GAILLON: AN ADDITION TO THE MARINE ALGAL FLORA OF NEW HAMPSHIRE. On 13 August 1971, several plants of *Lomentaria clavellosa* were collected at Dover Point, Dover, New Hampshire. Attached plants were found on rocks about 3 feet below mean low water near the concrete support of the northbound section of the General Sullivan Bridge. It was reported in North America for the first time in 1963, from three stations in Boston Harbor, Massachusetts (Wilce and Lee, 1964). Since 1963, it has also been reported from Marthas Vineyard and Woods Hole in Massachusetts. The occurrence of *L. clavellosa* at Dover Point is not only a northward extension of its previously known North American range but it is the first record of this species from an estuarine environment in North America. However, although Dover Point is located several miles from the open coast (it is the confluence of the Piscataqua River and Little Bay), its algal flora is unique, with definite coastal as well as estuarine species present (Mathieson, Reynolds & Hehre, in press). Voucher specimens are deposited in the Algal Herbaria at Southampton College, the University of New Hampshire and the University of Puerto Rico at Mayaguez.

I would like to thank the following people for their assistance in obtaining specimens of *Lomentaria clavellosa*: Messrs. R. Shepp, R. Szita, D. Fallon, Miss Dorothy Meyers and Miss Debbie Near.

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REVISION OF THE GENUS MELAMPODIUM (COMPOSITAE: HELIANTHEAE)[1]

TOD F. STUESSY

(Continued from page 70)

II. **Melampodium** section **Zarabellia** (Cass.) DC.

Melampodium L. sect. *Zarabellia* (Cass.) DC. Prodr. 5: 519. 1836. *Zarabellia* Cass. Dict. Sc. Nat. 59:240. 1829. Type species: *Melampodium longifolium* Cerv. ex Cav.

Tap-rooted annuals; leaves rhombic to deltoid (rarely narrowly ovate), sessile or shortly petiolate, with margins entire to obscurely serrate; outer involucre usually cupulate or less often spreading, with bracts 3-5, at margins herbaceous; ovaries of the disc florets ovoid, less than 0.7 mm long, rudimentary (Figs. 3 & 4); fruits at apex nearly smooth or moderately sculptured, or sometimes with an abaxial protuberance (in *M. longifolium*, Fig. 7); chromosome base number, $x = 9$. Species 21-25.

21. **Melampodium longifolium** Cerv. ex Cav. Anal. Cien. Nat. 6:333. 1803. *non* Brouss. ex Willd. 1809. TYPE: "NUEVA HISPANIA": grown from seed in the Royal Bot. Gard. Madrid, flowering Jun-Sep, *V. Cervantes* s.n. (Holotype, MA?; isotype, G!; photograph of G-DC isotype, IDC 800. 927: III. 6!; photograph of G isotype, F! US!).

Melampodium longifolium Brouss. ex Willd. Enum. Plant. Hort. Berol. 934. 1809. *nom. illegit. non* Cerv. ex Cav. 1803.

TYPE: MEXICO: locality, date, and collector unknown, cultivated in Bot. Gard. Berlin and harvested in 1808 (Holotype, B; photograph of holotype, TEX!).

Zarabellia rhomboidea Cass. Dict. Sc. Nat. 59:241. 1829. TYPE: cultivated in Bot. Gard. Paris, source of seeds unknown (Holotype, P?; photograph of possible G-DC isotype, IDC 800. 927: III. 7!).

Dysodium divaricatum Hort. ex DC. Prodr. 5:520. 1836. *non* Rich. in Pers. 1807. *nom. illegit., pro syn.*

Melampodium rhomboideum (Cass.) DC. Prodr. 5:520. 1836.

Melampodium parvulum Brandg. Zoe 5:262. 1908. TYPE: MEXICO: Puebla, Cerro Santa Lucia, Jul 1907, *C. A. Purpus* 2813 (not 2813′) (Holotype, UC!; isotypes, F! GH! NY! US!; photograph of US isotype, TEX!).

Annual herbs, 8-45 cm long. Stems erect, 1.5-4 mm diam, moderately hispid near base to copiously hispid above with hairs 0.8 mm long. Peduncles 0-21 mm long. Leaves sessile, rhombic (rarely elliptic, younger leaves often lanceolate-ovate), 2.5-6 cm long, 0.5-2.7 cm wide, at apex acute, at base subauriculate, with both surfaces moderately pubescent with hairs 0.3 mm long; margin obscurely serrate. Heads 3-4 mm tall, 5-7 mm diam. Outer involucre spreading, 7-10 mm diam; bracts 5 (rarely 4), separate, lanceolate, 3-5 mm long, 1.2-2 mm wide, at apex acute-acuminate, with abaxial surface glabrous to moderately pubescent (very pubescent at base) with hairs 0.7 mm long; margin herbaceous. Fruits 2.2-3 mm long, with lateral surfaces with 2 large irregular cavities. Ray florets 5-8; ligules yellow, ovate-elliptic, 1.3-1.5 mm long, 0.8-0.9 mm wide. Disc florets 10-15; corollas yellow, 0.8 mm diam, with throat 0.7 mm and tube 0.6 mm long. Paleae oblong, 1.4 mm long, 0.7 mm wide; apex colorless, with margin erose; midrib distinct, glabrous. Chromosome number, $n = 9$.

Scattered throughout pine-oak forests in the Mexican states of Nuevo Léon, San Luis Postosí, México, Distrito

Federal, Puebla, and Oaxaca (Fig. 12), 1830-2740 m. Flowering dates, Aug-Sep.

REPRESENTATIVE SPECIMENS. **Mexico.** DISTRITO FEDERAL: Tlalpán, Pedregal, Valley of Mexico, 20 Aug 1896, *Harshberger* 176 (GH); Tlalpán, Pyramid of Cuicuilco, 15 Aug 1935, *MacDaniels* 53 (F); Valley of Mexico near Tlalpán, 20 Aug 1896, *Pringle* 6455 (F, GH, NY, UC, US); Pena Pobre near Tlalpán, 8 Aug 1944, *Sharp* 44208 (NY). MÉXICO: near El Oro, 14 Sep 1901, *Pringle* 9325 (F, GH, US). NUEVO LEÓN: Hacienda Pablillo, Galeana, 8 Aug 1936, *Taylor* 115 (DS, F, NY, RSA, TEX). OAXACA: N limits of Las Sedas, 15 Aug 1966, *Stuessy* 659 (TEX). PUEBLA: vicinity of Puebla, 9 Sep 1906, *Arsène* 76 (US), 27 Oct 1907, *Arsène* 1199 (US), 10 Sep 1910, *Nicolas* 5447 (GH, US), s.n. (NY); Teocalli de Cholula, near Puebla, 25 Sep 1909, *Nicolas* s.n. (NY); Rancho Posadas, near Puebla, 25 Sep 1909, *Nicolas* s.n. (NY); vicinity of San Luis Tultitlanapa, Aug 1908, *Purpus* 2813′ (F, GH, NY, UC, US). SAN LUIS POTOSÍ: vicinity of San Luis Potosí, 1878, *Parry & Palmer* 444 (F, GH, NY, US); 22 mi E of San Luis Potosí, 5 Aug 1961, *Powell & Edmondson* 551 (F, TEX).

22. **Melampodium mimulifolium** Robins. Proc. Amer. Acad. Arts & Sci. 36:462. 1901. TYPE: MEXICO: Oaxaca, Totontopec, 1700-2150 m, 15 Jul 1894, *E. W. Nelson* 740 (Holotype, US!; photograph of holotype, TEX!).

Annual herbs, over 30 cm tall. Stems erect, 2-3 mm diam, subglabrous below to pilose-villous above with hairs 1 mm long. Peduncles 3-4.2 cm long. Leaves sessile, lanceolate-elliptic, 4.5-6.8 cm long, 1.5-2.2 cm wide, at apex acuminate, at base subauriculate to auriculate, with both surfaces strigose with hairs 0.4-1 mm long; margin entire to serrulate. Heads 6-7 mm tall, 8-10 mm diam. Outer involucre spreading to shallowly cupulate, 8-9 mm diam; bracts 5, slightly connate at base, ovate-lanceolate, 5-6 mm long, 2-2.5 mm wide, at apex acute, with abaxial surface moderately pilose with hairs 0.5-1 mm long; margin herbaceous. Fruits 2-2.1 mm long, with lateral surfaces smooth-striate with enlarged tuberculate margins. Ray florets ca 8; ligules yellow-orange, ovate, 3-4 mm long, 1.5-3 mm wide. Disc florets ca 50; corollas yellow, 1 mm diam, with throat 0.8 mm and tube 1.4 mm long. Paleae oblanceolate-obovate, 2.2 mm long, 0.8 mm wide; apex yellow, with margin erose-

laciniate; midrib weak, glabrous. Chromosome number unknown.

Known only from the type collection from pine-oak forests at Totontopec, Oaxaca, Mexico (Fig. 12), 1700-2150 m. Flowering date, Jul.

M. mimulifolium is very similar to *M. gracile*, and in fact, additional collecting may disclose transitional specimens that might suggest merger of the two species. At present, however, *M. mimulifolium* seems treated best as a distinct species that can be distinguished from *M. gracile* by the former's shorter peduncles, narrower leaves, longer and narrower outer phyllaries, and absence of stipitate-glandular hairs anywhere on the plant.

23. **Melampodium gracile** Less. Linnaea 6:407. 1831. TYPE: MEXICO: Veracruz, Papantla, Jan 1829, *C. J. W. Schiede & F. Deppe* 1254 (Lectotype, HAL!; isotypes, HAL! P! W! MO! photograph of lectotype, OS! TEX!; photograph of HAL isotype, OS! TEX!; photograph of P isotype, OS! TEX!).

Melampodium oblongifolium DC. Prodr. 5:519. 1836. TYPE: MEXICO: Veracruz, "rancho de los huevos" [from label] near Tantoyuca, Jan 1832, *J. L. Berlandier* 2153 [= 733] (Lectotype chosen, G-DC; isotypes, F! G [2]! GH! K [2]! MO! P!; photograph of lectotype, IDC 800. 927: III. 2!; tracing of lectotype, GH!; photograph of G-DC isotype, IDC 800. 927: III. 3!; photograph of K isotypes, US [2]!).

Melampodium gracile Less. var. *oblongifolium* (DC.) A. Gray, Proc. Amer. Acad. Arts & Sci. 5:182. 1861.

Melampodium microcarpum S. F. Blake, Contrib. U. S. Nat. Herb. 22:606. 1924. TYPE: MEXICO: Tamaulipas, vicinity of Gómez Farías, ca 350 m, 13-21 Apr 1907, *E. Palmer* 319 (Holotype, US!; isotype, GH! MO!; photograph of holotype, TEX! UC!).

Annual herbs, 17-50 cm tall. Stems erect, 1.2-4 mm diam, hispid-pilose and weakly stipitate-glandular with hairs 0.1-2 mm long. Peduncles 5.5-11.5 cm long. Leaves sessile,

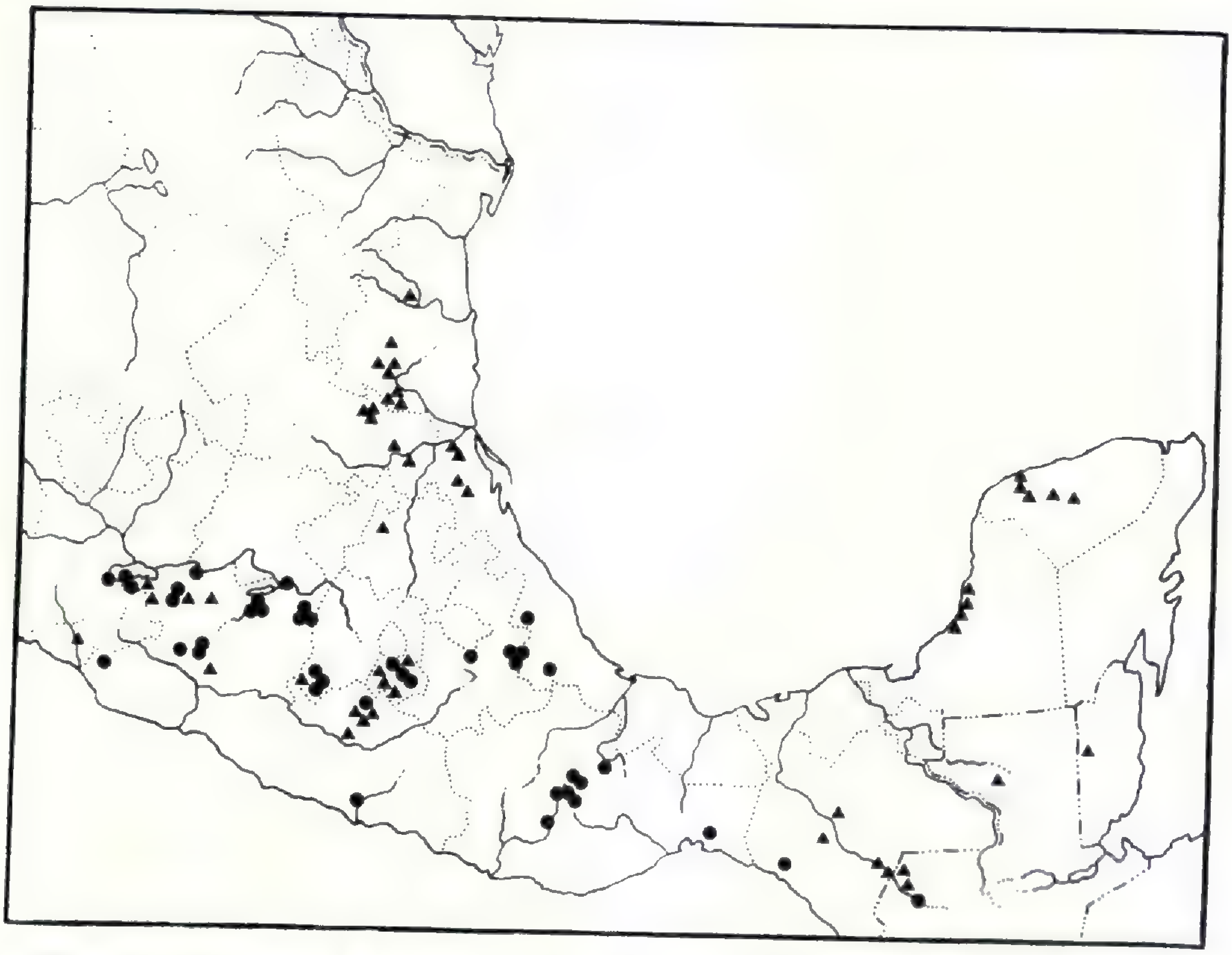

Fig. 21. Map of Mexico and adjacent Guatemala and British Honduras showing distribution of *Melampodium gracile* (triangles), and *M. microcephalum* (dots).

usually deltoid (younger leaves often lanceolate), 5-10 cm long, 2-4 cm wide, at apex acute to acuminate, at base narrowed and dilated near stem to subauriculate (rarely obtuse), with both surfaces strigillose with hairs 0.2 mm long; margin obscurely crenate to irregularly cleft. Heads 6-7 mm tall, 8-15 mm diam. Outer involucre spreading to shallowly cupulate, 7-10 mm diam; bracts 3 (sometimes 4 or 5), slightly connate at base, imbricate 1/3 their length, ovate, 3.5-5 mm long, 2.5-3.5 mm wide, at apex acuminate, with abaxial surface strigose with hairs 0.3-1 mm long near apex, near base stipitate-glandular with hairs 0.1-0.2 mm long; margin herbaceous. Fruits 2.3-2.5 mm long, with lateral surfaces reticulate and striate to tuberculate. Ray florets 5-8; ligules yellow-orange, ovate, 2-5 mm long, 3-4 mm wide. Disc florets 30-45; corollas yellow-orange, 1.5

mm diam, with throat and tube each 0.9 mm long. Paleae oblanceolate-obovate, 2.2 mm long, 0.8 mm wide; apex yellow-orange, with margin entire to dentate-laciniate laterally; midrib absent. Chromosome number, $n = 9$.

Pine-oak, tropical deciduous, tropical evergreen, and rain forests on the Gulf side of the Sierra Madre Oriental and the Yucatan Peninsula, and on the Pacific sides of the Sierra Madres Occidental and Sur, with extensions into British Honduras and northwestern Guatemala (Fig. 21), 30-1830 m. Flowering dates, Jul-Oct.

Melampodium gracile is very similar morphologically and geographically to *M. microcephalum,* but the two differ in several features such as habit, and the shapes of leaf bases, outer involucral bracts, and ligules. Single populations of both species have been crossed reciprocally in the greenhouse, and although robust F_1 hybrids are obtained, they are almost completely sterile. Detailed analyses of hybridization among all three species in the genus that have stipitate-glandular peduncles (*M. gracile, M. microcephalum* and *M. paniculatum*) currently are in progress and the results will be reported in a separate paper.

REPRESENTATIVE SPECIMENS. **British Honduras.** EL CAYO: San Agustín, Jul-Aug 1936, *Lundell* 6759 (ARIZ, GH, NY, TEX [2], US). **Guatemala.** HUEHUETENANGO: between San Sebastián H. & San Rafael Pétzal, 14 Aug 1942, *Steyermark* 50539 (F); between Nentón & Miramar, 29 Aug 1942, *Steyermark* 51452 (F, UC). PETÉN: vicinity of La Libertad, Aug-Nov 1933, *Aguilar* 25 (F [photograph of US specimen], NY, US). **Mexico.** CAMPECHE: Champotón, 7-15 Jul 1932, *Steere* 1805 (US); 1 mi W of Champotón, 18 Jul 1966, *Stuessy* 531 (TEX); 16 mi N of Champotón, 18 Jul 1966, *Stuessy* 533 (TEX); 12 mi S of Campeche, 25 Jul 1966, *Stuessy* 546 (TEX). CHIAPAS: ca 28 mi SE of Comitán, 25 Jun 1960, *King* 3042 (DS, NY, TEX, UC, US); ca 17 mi S of Tuxtla Gutiérrez, 27 Jun 1960, *King* 3096 (DS, NY, TEX, UC, US); 10 mi S of Bochil, 25 Jul 1966, *Stuessy* 562 (TEX); 32 mi SE of Comitán, 26 Jul 1966, *Stuessy* 574 (TEX). COLIMA: 7 mi S of Colima, 25 Aug 1966, *Stuessy* 722 (TEX). GUERRERO: Acuitlapán, 24 Sep 1937, *Abbott* 439 (GH); Río Balsas, Aug 1910, *Orcutt* 4365 (F); near Iguala, 14 Sep 1900, *Pringle* 9177 (F, GH, SMU, UC, US), 10 & 12 Aug 1905, *J. N. & J. S. Rose, & Painter* 9308 (GH, US). HIDALGO: Jacala, 20 Oct 1937, *Kenoyer* 427 (F). MÉXICO: Temas-

caltepec, Anonas, 24 Jul 1934, *Hinton* 6338 (US). MICHOACÁN: ca 4 mi E of Jiquilpán, 6 Aug 1960, *King* 3636 (DS, NY, TEX, UC, US); ca 3 mi E of Zamora, 6 Aug 1960, *King* 3646 (DS, NY, TEX, UC, US); 30 mi NW of Zamora, 2 Sep 1965, *Stuessy* 393 (TEX); 25 mi S of Ario de Rosales, 20 Aug 1966, *Stuessy* 694 (TEX); 2 mi S of jct rte 15 & rd to Cotija, 24 Aug 1966, *Stuessy* 713 (TEX). MORELOS: ca 11 mi S of Cuernavaca, 14 Mar 1961, *King* 4165 (TEX); 6 mi W of Yautepec, 14 Aug 1950, *Pipes* 81 (SMU); valley near Jojutla, 17 Jun 1901, *Pringle* 8466 (F, GH, NY, POM, UC, US); near Yautepec, 27 Oct 1902, *Pringle* 9937 (F, GH, NY, US); 7 mi NW of Cuautla, 25 Aug 1965, *Stuessy* 356 (TEX). SAN LUIS POTOSÍ: El Pujal, Río Tampaón valley, 21 Jul 1939, *Chase* 7533 (ARIZ, F, GH, NY); El Salto, 15 Jun 1951, *Holman & Dittman* 791 (SMU); El Salto, 14 Jun 1951, Kay & Higgins 202 (SMU); El Salto, 20 Feb 1961, *King* 3887 (F, NY, TEX, US); 48 mi N of Tamazunchale, 23 Aug 1957, *Waterfall & Wallis* 14288 (SMU). TAMAULIPAS: 7 mi N of Padilla, 9 Jun 1951, *Paynet & Hulan* 1213 (SMU, TEX); 10 km NW of El Progreso, 22 Aug 1941, *Stanford, Retherford & Northcraft* 1078 (ARIZ, DS, GH, NY); 15 mi SW of Ciudad Mante, 9 Aug 1965, *Stuessy* 274 (TEX [2]); ca 3-4 mi E of Nuevo Morelos, 5 Jul 1966, *Stuessy* 463 (TEX); 3 mi E of Gómez Farías, 8 Jun 1967, *Stuessy* 826 (TEX). VERACRUZ: Huasteca, Wartenberg, near Tantoyuca, 1858, *Ervendberg* 92 (GH); 13 mi W of Orizaba, 18 Nov 1959, *Graham & Johnston* 4777 (TEX); 7 mi SW [SE] of Morelos, 12 Aug 1961, *Powell & Edmondson* 646 (F, TEX); Jalapa, 1894, *Smith* 1605 (GH, UC); 18 mi S of jct rtes 110 & 105, 6 Jul 1966, *Stuessy* 466 (TEX). YUCATÁN: Progreso, *Gaumer* 2349 (F); Izamal, 1895, *Gaumer & sons* 789 (DS, F, GH [2], NY [2], POM, UC [3], US); at km 13 on Merida-Progreso rd, May-Aug 1938, *C. & A. Lundell* 7972 (DS, F, TEX, UC, US); 13 km N of Merida, 20 Jul 1966, *Stuessy* 537 (TEX); 86 mi W of Valladolid, 21 Jul 1966, *Stuessy* 544 (TEX [2]).

24. **Melampodium microcephalum** Less. Linnaea 9:268. 1834. TYPE: MEXICO: in cultivation near Hacienda de la Laguna, Jul 1829, *C. J. W. Schiede* 217 (Holotype, HAL!; isotype, P!; photograph of holotype, OS! TEX!; photographs of P isotype, F! OS! TEX! US!).

Melampodium lanceolatum Sessé & Moc. Fl. Mex. ed. 2. 196. 1894. *nom. illegit. non* DC. 1836. TYPE: "calidoribus Novae Hispaniae regionibus," Jul 1795-1804, *M. Sessé et al.* "3978" (Lectotype chosen, MA! [drawing of stem with two pairs of leaves on reverse side of label]; isotypes, MA [3]!).

Annual herbs, 15-75 cm tall. Stems erect to decumbent and rooting at nodes, 1-2 mm diam, villous and weakly stipitate-glandular with hairs 0.1-1 mm long. Peduncles 2.5-6.5 cm long. Leaves sessile or with petioles 1-4 mm long, ovate-lanceolate, 3-6.5 cm long, 0.9-3.5 cm wide, at apex acute to obtuse, at base attenuate to obtuse, with both surfaces strigose with hairs 0.2-1 mm long; margin entire to obscurely crenate. Heads 3-4 mm tall, 5-10 mm diam. Outer involucre spreading to shallowly cupulate, 5-8 (-10) mm diam; bracts 3 (sometimes 4 or 5), slightly connate at base, separate, narrowly ovate, 3-4.5 mm long, 1.5-3 mm wide, at apex acuminate, with abaxial surface pilose-villous and stipitate-glandular with hairs 0.1-1 mm long; margin herbaceous. Fruits 1.7-2 mm long, with lateral surfaces rugose-reticulate with enlarged tuberculate margins. Ray florets 5-8; ligules yellow-orange, elliptic, 2.5-4 mm long, 2-3 mm wide. Disc florets 35-50; corollas yellow-orange, 1.6 mm diam, with throat 1 mm and tube 0.7 mm long. Paleae oblanceolate-obovate, 2 mm long, 0.8 mm wide; apex yellow, with margin serrulate-laciniate; midrib absent. Chromosome number, $n = 9$.

Mostly pine-oak, tropical deciduous and tropical evergreen forests in many states of Mexico in the Mesa Central and the Sierra Madres Occidental and Sur, and in adjacent Guatemala (Fig. 21), 50-1740 m. Flowering dates, Jun-Nov.

M. microcephalum is often confused with *M. gracile* and *M. paniculatum*. Although all these taxa possess three outer involucral bracts, stipitate-glandular stems and peduncles, and chromosome numbers on a base of $x = 9$, the size of the heads and the shapes of the leaf bases can be used to distinguish easily one from another (see key).

In most taxa of *Melampodium* the number of outer involucral bracts is very constant, but in both *M. microcephalum* and *M. gracile*, as seen from field and greenhouse studies, plants occasionally are found with four or five bracts instead of the usual three.

REPRESENTATIVE SPECIMENS. **Guatemala.** HUEHUETENANGO: ca 6 mi S of Huehuetenango, 18 Jul 1960, *King* 3425 (DS, NY, TEX, UC, US). **Mexico.** CHIAPAS: 10 mi SE of Tonalá, 10 Aug 1966, *Stuessy* 627 (TEX). GUANAJUATO: near Acambaro, 18 Oct 1904, *Pringle* 13069 (F, GH, SMU, UC). GUERRERO: Taxco, 28 July 1937, *Abbott* 304 (GH); 20 mi NE of Acapulco, 20 Aug 1947, *Barkley, Webster & Paxson* 17M732 (TEX); Mina, Manchón, 7 Aug 1936, *Hinton* 9205 (ARIZ); Mina, Río Frio, 25 Sep 1937, *Hinton et al.* 10719 (ARIZ, GH, POM, TEX, US). JALISCO: Cerro Viejo, above Zapotitán de Hidalgo, ca 45 mi S of Guadalajara, 27 Jun 1956, *Gregory & Eiten* 205 (SMU). MÉXICO: Temascaltepec, Volcán, 10 Sep 1932, *Hinton* 1661 (F, GH, NY [2], US); Temascaltepec, Bejucos, 6 Oct 1932, *Hinton* 2008 (DS, F, NY [2], US); Temascaltepec, Ixtapán, 22 Jun 1934, *Hinton et al.* 6207 (F, GH, US). MICHOACÁN: 7 mi W of La Piedad, 6 Oct 1962, *Cronquist* 9613 (NY, TEX, US); ca 3 mi S of Ciudad Hidalgo, 4 Aug 1960, *King* 3607 (DS, NY, TEX, UC, US); ca 22 mi S of Uruapán, Cerro de Carboneras, 16-22 Oct 1961, *King & Soderstrom* 4804 (NY, SMU, TEX, UC, US); Lake Cuitzeo, 26 Oct 1892, *Pringle* 4322 (F, GH [2, one a tracing], NY, UC [2], US); 6 mi NW of Tuxpán, 1 Sep 1965, *Stuessy* 383 (TEX). MORELOS: El Teycal, 9 km SW of Tepoztlán, 30 Aug 1955, *Clausen* s.n. (NY); Cuantla, Aug 1904, *Kuntze* 23527 (NY [3]); Yautepec, 30 May 1939, *Nagel* 8030 (GH); Barranca, near Cuernavaca, 2 Nov 1896, *Pringle* 7321 (GH, US); Moyotepec, 8 Nov 1964, *Ripley & Barneby* 13708 (NY). OAXACA: Cerro de San Felipe, 26 Sep 1897, *Conzatti & González* 550 (GH, US); 10-12 km E of Niltepec, 18 Jul 1959, *King* 1833 (NY, SMU, TEX, UC, US); vicinity of Choapám, 28-29 Jul 1894, *Nelson* 870 (US); 1 mi E of Monte Albán, 12 Aug 1966, *Stuessy* 638 (TEX); 29 mi S of Zimatlán, 12 Aug 1966, *Stuessy* 640 (TEX). PUEBLA: Mt Orizaba, *Botteri* 809 (F, GH); near Puebla, Jul 1888, *Hoffmann* 832 (GH); Orizaba, 27 Mar 1887, *Millspaugh* s.n. (F); Mt Orizaba, 24 Aug 1891, *Seaton* 461 (F, GH, NY, US). VERACRUZ: Tantoyuca, Dec 1830, *Berlandier* s.n. (GH); valley of Córdoba, 20 Jan 1866, *Bourgeau* 1628 (GH, US); valley of Córdoba, 23 Apr 1865-66, *Bourgeau* 1629 (US); Pacho, near Jalapa, Jan 1894, *Smith* 1655 (F, NY, RSA).

25. **Melampodium paniculatum** Gardn. Hook. Lond. Jour. Bot. 7:287. 1848. TYPE: BRAZIL: Goias, near Arraias, Apr [Feb?] 1840, *G. Gardner* 3844 (Holotype, K!; isotypes, F [2]! G [2]! NY [2]! P! W!; photograph of holotype, US!; photograph of G isotype, F! US!).

Melampodium laxum Sch. Bip. Ber. Bot. Zeit. 3:155. 1845. *nom. nud.* Based on *G. Gardner* 3844.

Melampodium brachyglossum J. D. Smith, Bot. Gaz. 13: 74. 1888. TYPE: GUATEMALA: Alta Verapaz, Cobán, 4300 ft, May 1886, *H. von Tuerckheim* 114 (Lectotype chosen, US!; isotype, US!; photograph of holotype, TEX!). K, NY & P specimens that bear exactly the same printed label as the lectotype are clearly *Jaegeria hirta* (Lag.) Less. (see Torres, 1968, for agreement). It is probably a labeling error.

Annual herbs, 13-70 cm tall. Stems erect, 0.7-5 mm diam, hispid and stipitate-glandular with hairs 0.1-1 mm long. Peduncles 1.1-5 cm long. Leaves sessile or with petioles up to 5 mm long, ovate-rhombic (younger leaves approaching lanceolate), 3-9 cm long, 1-5 cm wide, at apex acute to acuminate, at base attenuate, often dilated almost to subauriculate, with both surfaces strigose with hairs 0.3-1 mm long; margin entire to irregularly serrate-crenate. Heads 2.2-4.5 mm tall, 3-5.5 mm diam. Outer involucre cupulate, 3-7 mm diam; bracts 3, separate, ovate, 1.8-4 mm long, 1.5-2.8 mm wide, at apex acute-acuminate, with abaxial surface strigose and stipitate-glandular with hairs 0.1-0.8 mm long; margin herbaceous. Fruits 2-2.8 mm long, with lateral surfaces with longitudinal ribs and striations. Ray florets 3-5; ligules yellow, ovate, 1-2 mm long, 1-2 mm wide. Disc florets 10-15; corollas yellow, 1.1 mm diam, with throat and tube each 0.8 mm long. Paleae elliptic, 1.3 mm long, 0.7 mm wide; apex yellow-orange, with margin laciniate; midrib weak, glabrous. Chromosome numbers, $n = 8$ and 27.

Low tropical mountains of Chiapas, Mexico, Central America (excluding British Honduras, Nicaragua, and Panama), and isolated points of Colombia and Brazil in South America (Figs. 22 & 23), 370-2010 m. Flowering dates, Jan-Dec.

Adding to the chromosomal diversity already existing in *Melampodium* are the new counts in *M. paniculatum* of $n = 27$ reported from two different populations in Brazil

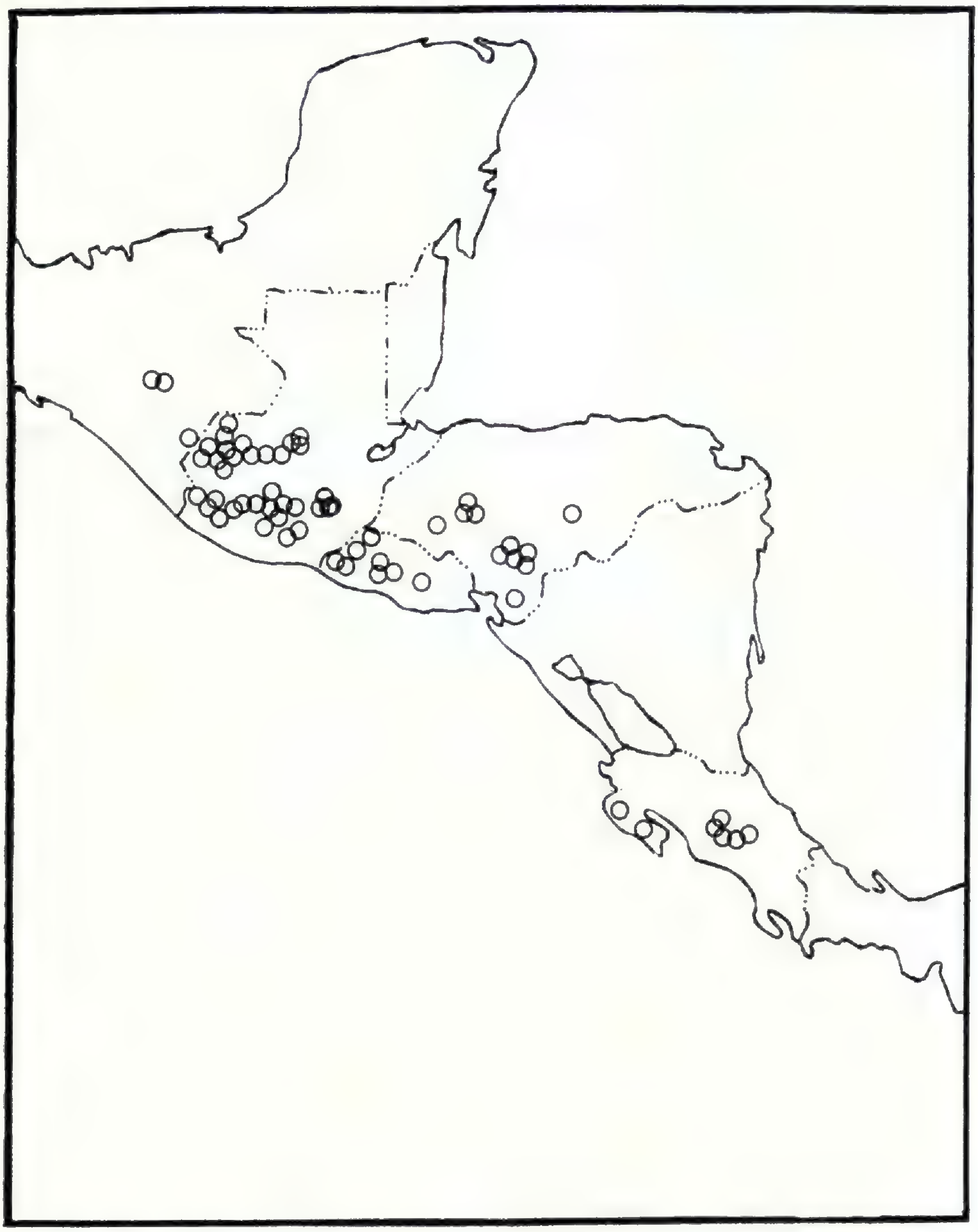

Fig. 22. Map of Central America showing distribution of *Melampodium paniculatum*. See Fig. 23 for South American localities.

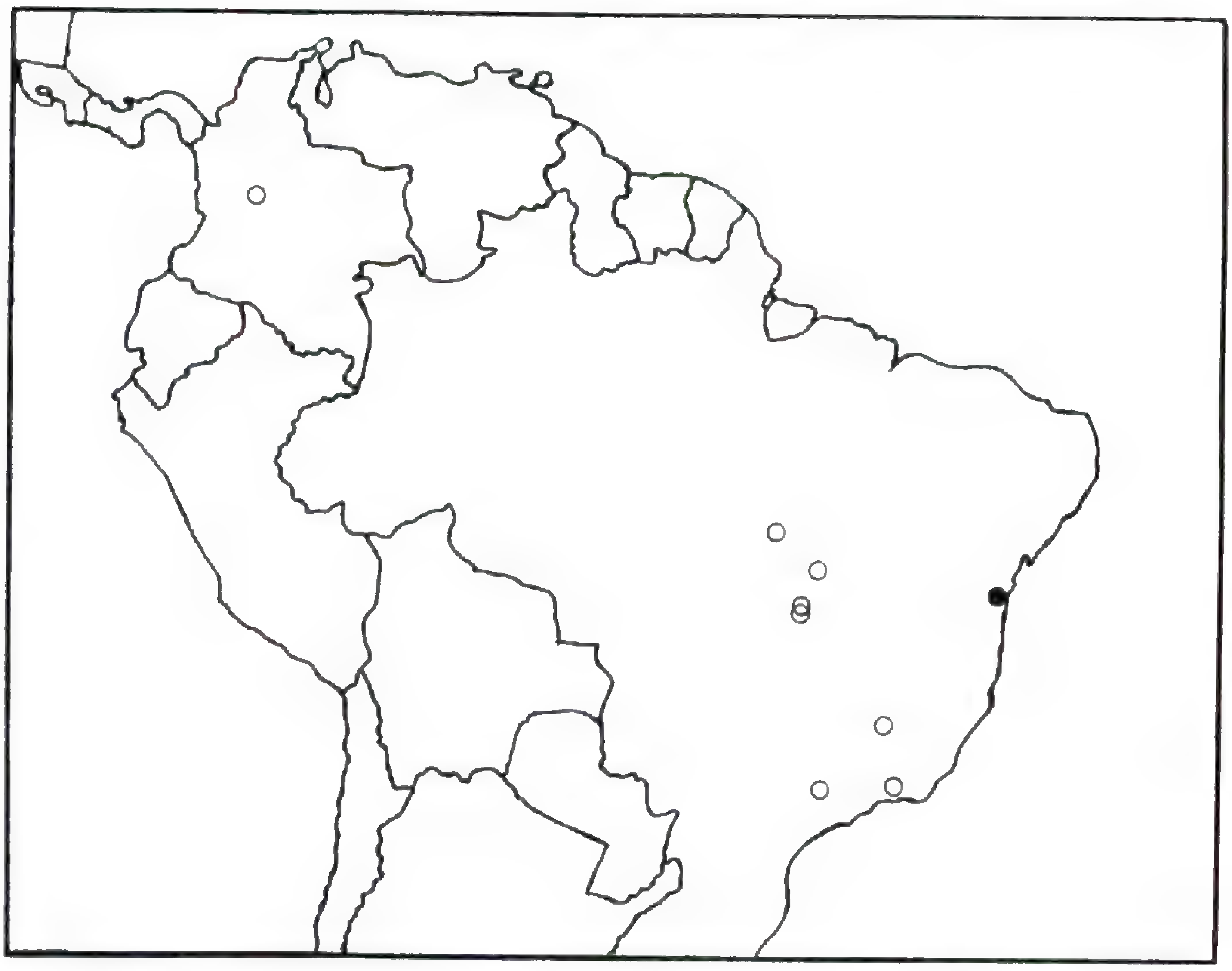

Fig. 23. Map of South America showing distribution of *Melampodium divaricatum* (dot), and *M. paniculatum* (circles).

by Coleman (1970)[14]. I have examined the cited voucher specimens, and due to an absence of significant morphological differences between the $n = 18$ and $n = 27$ cytotypes, it seems best at this time to consider these chromosomally distinct populations as simply polyploid races of a single species. It is interesting to note, however, that the tetraploid counts of $n = 18$ prevail in Central America while the chromosomally derived hexaploid populations of $n = 27$ are found only in Brazil where *M. paniculatum* probably has been recently introduced by man. *M. paniculatum* thus joins *M. cinereum*, *M. dicoelocarpum* and *M. leucanthum* as the fourth species in the genus known to have intraspecific euploidy.

[14]These new counts actually were listed as $n = 26$-27 and $n = 26$. In recent correspondence regarding these counts, however, Dr. Coleman states that "On restudying the slide, I have decided that the correct number of the material I counted is $n = 27$."

REPRESENTATIVE SPECIMENS. **Brazil.** FEDERAL DISTRICT: Córrego Landim, ca 20 km N of Brasilia, 15 Dec 1965, *Irwin, Souza & Santos* 11303 (TEX); Corallino, 1817-21, *Pohl* 1368 [1276] (NY). GOIAS: near Arraias, Apr 1840, *Gardner* 287 (NY). MATO GROSSO: Sta Terezinha, 12 Feb 1948, *Macedo* 1408 (US). MINAS GERAIS: 1838, *Clausen* s.n. (F, NY [2], US); Belo Horizonte, Pampulha, Feb 1945, *Williams* 5643 (UC, US). RÍO DE JANEIRO: Río de Janeiro, Feb 1882, *Glaziou* 12794 (K). SÃO PAULO: São João de Boa Vista, 6 Sep 1893, *Lofgren & Edwall* 16695 (US). **Colombia.** CUNDINAMARCA: Bogotá, *Triana* 1331 (NY, US). **Costa Rica.** CARTAGO: 24 Aug 1924, *Torres* 50 (US). GUANACASTE: coffee plantations of San Francisco de Guadalupe, Jul 1892, *Pittier* 6963 (GH); Hatillo, 4 Jan 1935, *Solís* 52 (F). HEREDIA: Río Virilla on hwy to Heredia, 1 Dec 1937-1 Jan 1938, *Allen* 585 (F); Río Virrilla near La Uruca, Aug 1888, *Pittier* 429 (F, GH); Río Virilla near San Juan, Jun 1896, *Tonduz* 10144 (US [2]). SAN JOSÉ: San José, 4 Sep 1938, *Orozco* 260 (F); vicinity of San José, 6 Nov 1938, *Orozco* 418 (F); vicinity of Las Pavas, 29 Feb 1924, *Standley* 36058 (US); vicinity of San José, Feb 1924, *Standley* 38971 (US); Desamparados, 27 Jun 1923, *Stevens* 136 (US). **El Salvador.** AHUACHAPÁN: vicinity of Ahuachapán, 9-27 Jan 1922, *Standley* 20260 (GH), 16-25 Jan 1947, *Standley & Padilla* 2755 (F). LA LIBERTAD: Finca Paraíso, ¼ mi S of Sta Tecla, 14 Jan 1946, *Carlson* 106 (F, UC, US); Sta Tecla, 20 Jul 1941, *García* 51 (UC). SAN SALVADOR: Volcán de San Salvador, Apr 1922, *Calderón* 459 (GH, NY, US); San Salvador, 1922, *Calderón* 779 (GH, NY, US); vicinity of San Salvador, 30 Mar-24 Apr 1922, *Standley* 22687 (GH, US); Volcán de San Salvador, 7 Apr 1922, *Standley* 22864 (GH, NY, US); San Salvador, Nov 1906, *Velasco* 8946 (US). SANTA ANA: Cerro Miramundo, above Hacienda Los Planos, NE of Metapán, 25 Feb 1946, *Carlson* 873 (F); Finca of Los Naranjos, E of Cerro de los Naranjos, 27 Apr 1942, *Tucker* 1313 (F, NY, UC, US). SAN VICENTE: vicinity of San Vicente, 7-14 Feb 1947, *Standley & Padilla* 3630 (F). **Guatemala:** ALTA VERAPAZ: ca 4 mi NE of San Pedro Carchá, 12 Jul 1960, *King* 3329 (DS, NY, TEX, UC, US); 28 mi E of San Miguel Uspantán, 28 Jul 1966, *Stuessy* 589 (TEX); 1 mi NE of San Pedro Carchá, 29 Jul 1966, *Stuessy* 594 (TEX): Cobán, Jul 1885, *Tuerckheim* 761 (US), Mar 1903, 8417 (F, GH, NY, US). CHIMALTENANGO: near Río Pixcayó between Chimaltenango & San Martín Jilotepeque, 3 Feb 1939, *Standley* 64303 (F, NY); Finca La Alameda near Chimaltenango, 11-22 Dec 1940, *Standley* 79869 (F). EL QUICHÉ: Nebaj, 19 Nov 1934, *Skutch* 1709 (F, GH); 4 mi E of Cunén, 28 Jul 1966, *Stuessy* 585 (TEX); 11 mi E of San Miguel Uspantán, 28 Jul 1966, *Stuessy* 587 (TEX). ESCUINTLA: Finca Monterrey, Volcán de Fuego, 5 Feb 1939, *Standley* 64595 (F, NY); Los Diamantes, 9 Mar 1896, *Volkem* 2564 (GH, NY). GUATEMALA: near Finca La Aurora, 1938-39, *Aguilar* 322 (F). HUEHUE-

TENANGO: ca 3 mi S of Huehuetenango, 18 Jul 1960, *King* 3417 (DS, NY, TEX, UC, US); vicinity of Cuilco near Río Cuilco, 17 Aug 1942, *Steyermark* 50773 (F, GH); 2 mi S of Huehuetenango, 26 Jul 1966, *Stuessy* 578 (TEX); 1 mi W of Aguacatán, 27 Jul 1966, *Stuessy* 582 (TEX); Chaculá, 20 Aug 1896, *Volkem* 2774 (GH, NY, US). JALAPA: vicinity of Jalapa, 7-18 Nov 1940, *Standley* 76429 (F); between Jalapa & San Pedro Pinula, 12 Nov 1940, *Standley* 77073 (F); mts near Chahuite, NW of Jalapa, 16 Nov 1940, *Standley* 77440 (F); between Jalapa & Montaña Miramundo, 7 Dec 1939, *Steyermark* 32847 (F). QUEZALTENANGO: vicinity of San Francisco de Miramar, Costa Cuca, Apr 1905, *Pittier* 57 (F, US), *Pittier* 60 (F, US); between Colomba & Las Mercedes, 20 Feb 1941, *Standley* 87933 (F); San Francisco Miramar, 15 Mar 1921, *Tonduz & Rojas* 203 (US). RETALHULEU: *Finca Helvetia*, 6 May 1937, *Muenscher* 12467 (F). SACATEPÉQUEZ: Antigua, 12 Sep 1959, *O. & I. Degener* 26504 (US); Antigua, 13 Feb 1905, *Kellerman* 4501 (F, US); Antigua, Apr 1890, *Smith* 2334 (US); near Antigua, Nov 1938-Feb 1939, *Standley* 60326 (F, NY); Barranca above Dueñas, 21 Jan 1939, *Standley* 63265 (F, NY). SAN MARCOS: Río Cabús near Malacatán, 15 Mar 1939, *Standley* 68866 (F). SANTA ROSA: near Cerro Redondo, 20 Dec 1938, *Standley* 60413 (F); La Joya de Limón, E of Cuilapa, 25 Nov 1940, *Standley* 78268 (F). SOLOLÁ: Panajachel, near Lake Atitlán, 11 Sep 1959, *O. & I. Degener* 26559 (US); behind Lago de Atitlán near Panajachel, 5 Jul 1960, *King* 3242 (DS, NY, TEX, UC, US). SUCHITEPÉQUEZ: Finca Moca, 27 Oct 1934, *Skutch* 1550 (GH). **Honduras.** CHOLUTECA: vicinity of San Marcos de Colón, 12-22 Jan 1949, *Standley* 15756 (F). COMAYAGUA: vicinity of Siguatepeque, 14-27 Feb 1928, *Standley* 56290 (US), 56522 (F, US), 25 Mar-5 Apr 1947, *Standley & Chacón* 6625 (F), 6660 (F); Rittenhouse's hacienda, 30 Jun 1936, *Yuncker, Dawson & Youse* 5519 (F, GH). EL PARAÍSO: Güinope, Dec 1943, *Valerio* 1662 (F). INTIBUCÁ: vicinity of La Esperanza & Intibucá, 31 Jan-12 Feb 1950, *Standley* 25149 (F). MORAZÁN: Río Yeguare, 22 Jul 1948, *S. F. Glassman* 2003 (F, NY), 26 Aug 1951, *Williams* 18257 (F); near Río Yeguare, below El Zamorano, 10 Aug 1947, *Standley* 12105 (F); Cerro de Uyuca between Las Flores & Tatumbla, 17 Aug 1949, *Standley* 22718 (F); La Leona, Tegucigalpa, 6 Sep 1951, *Standley* 28678 (F); Zamorano, 7 Jan 1946, *Valerio* 3735 (F, GH). OLANCHO: vicinity of Juticalpa, 5-16 Mar 1949, *Standley* 17710 (F). **Mexico.** CHIAPAS: Tenejapa, Pokolum, 10 Jul 1964, *Breedlove* 6085 (DS, F); Chamula, Toh Tik on rd to Chenalho, 12 Dec 1964, *Breedlove* 7861 (DS, F); Los Lagos, 3 mi NW of Rancho San José, 18 Jan 1952, *Carlson* 2254 (F).

III. **Melampodium** section **Serratura** Stuessy, sect. nov.

Herbae annuae radicibus palaribus; folia rhombica vel deltoidea (raro anguste ovata), petiolata, marginibus serratis (raro integris); involucrum extimum cupulatum vel interdum patens, bracteis 5, marginibus herbaceis; ovaria flosculi disci ovoidea, minus quam 0.7 mm longa, rudimentales (Figs. 3 & 4); fructus apice fere laeves vel moderate sculpti et sine cucullis, vel complanata abaxiali arista (*M. tepicense*); chromosomatum numerus basicus, $x = 12$. Species 26-30. Typus: *Melampodium divaricatum* (Rich. in Pers.) DC.

26. **Melampodium divaricatum** (Rich. in Pers.) DC. Prodr. 5:520. 1836.

Dysodium divaricatum Rich. in Pers. Syn. 2:489. 1807. *non* Hort. ex DC. 1836. TYPE: COLOMBIA: "Gairam, prope St. Martham," 1785-89, *L. C. M. Richard* s.n. (Lectotype chosen, P!; isotype, P!; photograph of holotype, OS! TEX!; photograph of P isotype, OS!).

Wedelia ovatifolia Willd. Enum. Suppl. 61. 1814. TYPE: source of seed unknown, apparently grown in Bot. Gard. Berlin, "2421" (Holotype, B?; isotype, W!; photograph of W isotype, OS! TEX!; photograph of probable G-DC isotype, IDC 800. 928: I. 4!).

Alcina ovatifolia (Willd.) Jacq. f. Eclog. P1. 1:115. *t. 78.* 1815.

Wedelia minor Hort. ex Hornem. Enum. Hort. Hafn. 2:855. 1815. TYPE: introduced into the Bot. Gard. Copenhagen in 1812 from Berlin Bot. Gard., source of seed unknown (Lectotype, C!; isotypes, C [2]!; photograph of lectotype, OS! TEX!).

Alcina ovalifolia Lag. Gen. et Sp. Nov. 32. 1816. TYPE: "NOVA HISPANIA" [MEXICO]: seeds cultivated and grown in Bot. Gard. Madrid, 1805, *M. Sessé* s.n. (Holotype, MA!; isotype, G!; photograph of holotype, OS! TEX!; photograph of G isotype, OS! TEX!).

Melampodium paludosum H.B.K. Nov. Gen. Sp. 4:237. 1820. TYPE: PANAMA: "in humidis prope ostia fluminis sinu, juxta litora Dariensis," Mar 1801, *F. H. A. von Humboldt & A. J. Bonpland* 1421 (Holotype, P; isotype, P!; photograph of P isotype, OS! TEX!).

Melampodium ovatifolium Rchb. Icon. Bot. Exot. 30. *t. 42.* 1824. *nom. superfl.* Based on type of *Dysodium divaricatum* Rich. in Pers.

Melampodium berterianum Spreng. Syst. Veg. 3:619. 1826. TYPE: "IND. OCC." [COLOMBIA]: near Sta Martha, *C. G. Bertero* s.n. (Holotype, P!; probable isotype, GH!; photograph of holotype, OS! TEX [2]! US!; photograph of G-DC isotype, IDC 800. 928: I. 3!).

Alcina minor Cass. Dict. Sc. Nat. 59:243. 1829. TYPE: MEXICO: cultivated in Bot. Gard. Paris (Holotype, P?).

Dysodium radiatum Hort. ex Desf. Cat. Hort. Paris. ed. 3. 182. 1829. *pro syn.*

Melampodium pumilum Benth. Pl. Hartw. 64. 1840. TYPE: MEXICO: exact locality unknown, 1830, *G. J. Graham* 5 (Holotype, K!; isotype, GH!; photograph of holotype, OS! TEX! US!).

Melampodium tenellum Hook. & Arn. var. *flaccidum* Benth. Bot. Voy. Sulphur 115. 1845. TYPE: MEXICO: Nayarit, Tepic, 1844, *A. Sinclair* s.n. (Lectotype chosen, K!; isotype, K!; photograph of lectotype, US [3]!).

Melampodium divaricatum (Rich. in Pers.) DC. var. *macranthum* Schlecht. Linnaea 24:198. 1851. TYPE: GUATEMALA: locality and date unknown, seeds collected and grown in Bot. Gard. Turin, *J. von Warscewicz* s.n. (Holotype, HAL; isotype, W!; photograph of W isotype, OS! TEX!).

Melampodium flaccidum (Benth.) Benth. in Oerst. Kjoeb. Vidensk. Meddel. 5-7:86. 1852.

Melampodium copiosum Klatt, Engl. Bot. Jahrb. 8:41. 1887. TYPE: GUATEMALA: Alta Verapaz, near Cobán, 1300

m, Feb [May?] 1882, *F. C. Lehmann* 1434 (Holotype, GH!; isotypes, F! G [2]! K! US!; photograph of K isotype, US!; photograph and fragment of K isotype, US!).

Melampodium panamense Klatt, Engl. Bot. Jahrb. 8:42. 1887. TYPE: PANAMA: "ad margines silvarum," 20 Aug 1880, *F. C. Lehmann* 69 (Holotype, GH!; isotypes, G! K! US!; photograph of K isotype, US!).

Spilanthes guatemalensis Vatk. ex J. D. Smith, Enum. Pl. Guat. 1:23. 1889. *nom. nud.* Based on *H. von Tuerckheim* 124 (F! GH! NY! US [2]!).

Melampodium rhombifolium Sessé & Moc. Fl. Mexic. ed. 2. 195 [first on page]. 1894. *nom. illegit. non* Sessé & Moc. 1890. *nec* Sessé & Moc. [second on page]. 1894. TYPE: MEXICO: Michoacán, Temascaltepec, Jul 1790-1791, *M. Sessé et al.* "3983" (Holotype, MA!; isotype, F!; photograph of holotype, OS! TEX!).

Eleutheranthera divaricata (Rich. in Pers.) Millsp. Field Col. Mus. Pub. Bot. 1:53. 1895.

Annual herbs, 15-100 cm tall. Stems erect, with lateral stems sometimes decumbent and rooting at the nodes, 1.3-6 mm diam, glabrous to pubescent with hairs up to 0.7 mm long. Peduncles 1.5-13.5 cm long. Leaves with petioles 2-20 mm long, ovate to rhombic (younger leaves approaching lanceolate), 1.5-15 cm long, 0.5-9.5 cm wide, at apex acuminate to obtuse, at base attenuate (rarely obtuse to cordate), with both surfaces infrequently strigillose with hairs 0.2 mm long; margin entire to coarsely dentate-crenate. Heads 5-10 mm tall, 10-21 mm diam. Outer involucre cupulate, 6-9 mm diam; bracts 5, connate 1/3-1/4 their length, imbricate, ovate-orbiculate, 3.5-6 mm long, 3-5 mm wide, at apex obtuse, with abaxial surface glabrous to tomentose near peduncle; margin herbaceous, near base tomentose. Fruits 2.8-4 mm long, with lateral surfaces with diagonal striations and enlarged margins. Ray florets 8-13; ligules yellow-orange, oblong-elliptic, 3.5-7 mm long, 1.6-3 mm wide. Disc florets 40-70; yellow-orange, 2 mm diam, with throat

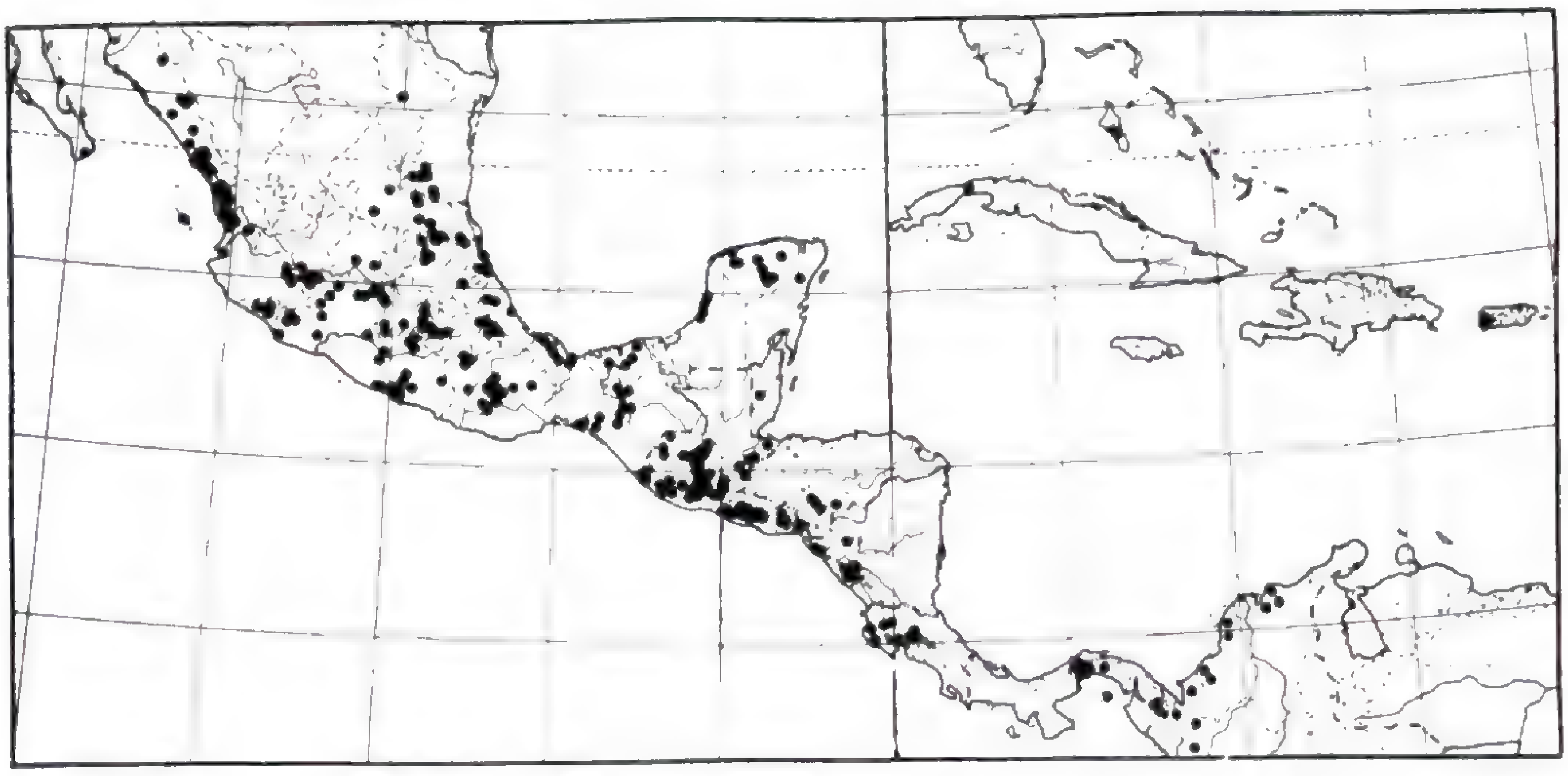

Fig. 24. Map of Mexico, Central America, northern South America, and the Caribbean region showing distribution of *Melampodium divaricatum*. See Fig. 23 for the one Brazilian locality. Collections from Burma and the Virgin Islands not shown.

1 mm and tube 0.5 mm long. Paleae obovate, 2.5 mm long, 0.9 mm wide; apex yellow-orange, with margin dentate-erose; midrib weak, glabrous. Chromosome number, $n = 12$.

Very widely spread in many subtropical habitats throughout Mexico, Central America, and northwestern Colombia, also in eastern Brazil, and introduced into Cuba, Burma, Puerto Rico and the Virgin Islands (Figs. 23 & 24), 15-2990 m. Flowering dates, Jan-Dec.

This is the most widespread and weedy species of the genus. Although field and garden studies have shown leaf shape to be extremely variable, which partially accounts for the many synonyms accorded this taxon, the morphology of the outer involucral bracts is very constant and allows the species to be recognized without difficulty. One plant from Nicaragua, *Stuessy* 615, has fruits with an anomalous hooded condition; other plants from the same population are hoodless.

REPRESENTATIVE SPECIMENS. **Brazil.** BAHÍA: 1842, *Glocker* 19 (US); Marau, 22 Jan 1965, *Pereira* 9616 & *Pabst* 8505 [34972] (F). **British**

Honduras. EL CAYO: El Cayo, near Camp 6, 11 Mar 1938, *Gentle* 2325 (ARIZ, F, GH, NY). **Burma.** MANDALA: Maymyo, Nov 1950, *White* 100 (US). **Colombia.** ANTIOQUÍA: near Dabeiba, 20 Dec 1947, *Barkley & Gutiérrez* 1777 (F). BOLÍVAR: vicinity of Turbaco, 6-22 Nov 1926, *Killip & Smith* 14169 (F, NY, US). CÓRDOBA: W of Montería, near Río Sinu, 6 Jan 1949, *Cervantes, Molina & Barkley* 19Bo061 (US). MAGDALENA: Sta Marta, Bonda, 9 Nov 1898-1899, *Smith* 514 in part (NY [3], UC); Sta Marta, Jul 1898-1901, *Smith* 514 in part (F, RSA, SMU, TEX, UC, US). **Costa Rica.** ALAJUELA: between San Josecito & La Garita, 18 Aug 1963, *Jiménez* 1073 (F, US). GUANACASTE: Nicoya, Dec 1899, *Tonduz* 13615 (NY, US). PUNTARENAS: 21 km SE of Puntarenas, near bridge over Río Barranca, 20 Aug 1938, *Stork & Morrison* 8920 (GH, UC). **Cuba.** HAVANA: Vedado, shore of Ariguanabo River, San Antonio de los Baños, 3 Sep 1939, *Léon, Victorín & Alain* 17344 (NY). **El Salvador.** AHUACHAPÁN: vicinity of Ahuachapán, 9-27 Jan 1922, *Standley* 19722 (GH, US). LA LIBERTAD: Finca Paraíso, ¼ mi S of Sta Tecla, 14 Jan 1946, *Carlson* 79 (F, UC, US). MORAZÁN: Río San Miguel opposite Barrios Mine, ca 5 km W of Montecristo, 19 Dec 1941, *Tucker* 585 (F, NY, UC, US). SAN MIGUEL: 39 mi W of La Unión, 7 Aug 1966, *Stuessy* 623 (TEX). SAN SALVADOR: 18 mi E of San Salvador, 2 Aug 1966, *Stuessy* 611 (TEX). SANTA ANA: 4 mi SE of Sta Ana, 2 Aug 1966, *Stuessy* 609 (TEX). SAN VICENTE: vicinity of San Vicente, 2-11 Mar 1922, *Standley* 21648 (GH, NY, US). SONSONATE: vicinity of Sonsonate, 18-27 Mar 1922, *Standley* 21789 (GH, NY, US). **Guatemala.** ALTA VERAPAZ: ca 2 mi E of Cobán, 12 Jul 1960, *King* 3322 (DS, NY, TEX, UC, US); 28 mi E of San Miguel Uspantán, 28 Jul 1966, *Stuessy* 588 (TEX); 1 mi NE of San Pedro Carchá, 29 Jul 1966, *Stuessy* 592 (TEX). BAJA VERAPAZ: ca 1 mi S of Rabinal, 14 Jul 1960, *King* 3359 (DS, NY, TEX, UC, US). CHIMALTENANGO: San Martín J., 1928, *Morales* 1221 (F). CHIQUIMULA: Montaña Nonojá, 3-5 mi E of Camotán, 11 Nov 1939, *Steyermark* 31670 (F). EL PROGRESO: between Finca Piamonte & Finca San Miguel, 9 Feb 1942, *Steyermark* 43745 (F, UC). EL QUICHÉ: 11 mi E of San Miguel Uspantán, 28 Jul 1966, *Stuessy* 586 (TEX). ESCUINTLA: 9 mi NE of Escuintla, 8 Aug 1966, *Stuessy* 624 (TEX). GUATEMALA: ca 4 mi E of Guatemala, 9 Jul 1960, *King* 3249 (DS, NY, TEX, UC, US). HUEHUETENANGO: Chacula, 29 Jul 1896, *Volkem* 3013 (GH, NY, US). IZABAL: Cristina, 23 May 1919, *Blake* 7632 (US). JALAPA: vicinity of Jalapa, 7-18 Nov 1940, *Standley* 77149 (F). JUTIAPA: 25 mi E of Cuilapa, 2 Aug 1966, *Stuessy* 605 (TEX); 8 mi NE of Jutiapa, 2 Aug 1966, *Stuessy* 608 (TEX). QUEZALTENANGO: Colomba, 31 Dec 1934, *Skutch* 2041 (F, GH). RETALHULEU: 1 mi W of jct rtes 2 & 9S, N of Retalhuleu, 10 Aug 1966, *Stuessy* 625 (TEX). SANTA ROSA: Volcán Jumaytepeque, Dec 1892, *Heyde et Lux* 4213 (F, GH, NY, US [2]). SUCHITEPÉQUEZ: Mazatenango, 28 Feb 1905,

Kellerman 4958 (SMU, US). ZACAPA: Gualán, 18 Jan 1905, *Deam* 247 (F, GH, NY, US). **Honduras.** EL PARAÍSO: Llano de Lizapa, 24 Aug 1948, *Molina* 1082 (F). FRANCISCO MORAZÁN: near San Francisco along Yeguare River, 16 Nov 1947, *Williams & Molina* 13398 (F, GH). VALLE: Amapala, 11 Sep 1945, *Valerio* 3341 (F [2]). **Mexico.** BAJA CALIFORNIA: San José del Cabo, 12 Sep 1890, *Brandegee* 301 (UC). CAMPECHE: 1 mi W of Champotón, 18 Jul 1966, *Stuessy* 532 (TEX); 14 mi N of Champotón, 18 Jul 1966, *Stuessy* 534 (TEX); 14 mi E of Campeche, 18 Jul 1966, *Stuessy* 535 (TEX); 12 mi S of Campeche, 22 Jul 1966, *Stuessy* 545 (TEX). CHIAPAS: ca 15 mi S of Suchiate, 20 Jul 1960, *King* 3434 (DS, NY, RSA, TEX, UC); 19 mi S of Pichucalco, 23 Jul 1966, *Stuessy* 550 (TEX). COLIMA: 4 mi E of Colima, 25 Aug 1966, *Stuessy* 723 (TEX); 7 mi NW of rte 110 on rd to Alzada, 25 Aug 1966, *Stuessy* 725 (TEX); Alzada, 25 Aug 1966, *Stuessy* 728 (TEX). DISTRITO FEDERAL: Sta Rosa, 4 Oct 1952, *Matuda* 26621 (US). GUANAJUATO: valley near Irapuato, 20 Sep 1889, *Pringle* 2819 (F, GH). GUERRERO: vicinity of Acapulco, Oct 1894-Mar 1895, *Palmer* 186 (F, GH, NY, US); 4 mi S of Taxco, 17 Aug 1961, *Powell & Edmondson* 756 (F, TEX); S limits of Petaquillas, 27 Aug 1965, *Stuessy* 365 (TEX). HIDALGO: Jacala, 25 Jun 1939, *Chase* 7122 (F). JALISCO: Río Cuvianes, 13 Jun 1892, *Jones* 273 (POM [2], US). MEXICO: Temascaltepec, 2 Sep 1932, *Hinton* 1520 (NY). MICHOACÁN: ca 45 mi W of Morelia, 5 Aug 1960, *King* 3634 (DS, NY, RSA, TEX, UC); 16 mi NW of Zitacuaro, 19 Aug 1966, *Stuessy* 677 (TEX); S city limits of Uruapán, 21 Aug 1966, *Stuessy* 702 (TEX). MORELOS: ca 11 mi S of Cuernavaca, 14 Mar 1961, *King* 4164 (F, NY, TEX, UC, US); 35.5 mi NW of Izúcar de Matamoros, 25 Aug 1965, *Stuessy* 348 (TEX); 6 mi NW of Cuautla, 25 Aug 1965, *Stuessy* 351 (TEX); 10 mi S of Cuernavaca, 26 Aug 1965, *Stuessy* 359 (TEX). NAYARIT: ca 16 mi NW of Ixtlán del Río, 10 Aug 1960, *King* 3678 (DS, NY, TEX, UC, US); 1 mi N of Tepic, 27 Aug 1966, *Stuessy* 743 (TEX); 10 mi NW of jct rte 16 & rd to Tuxpán, 27 Aug 1966, *Stuessy* 746 (TEX). NUEVO LEÓN: Villa de Santiago, Las Adjuntas, 21 Jun 1940, *Leavenworth* 157a (F). OAXACA: ca 1 mi W of the Oaxaca-Chiapas border on rte 190, 9 Jun 1960, *King* 2743 (DS, NY, TEX, UC, US); 0.7 mi N of Huajuapán de León, 24 Aug 1965, *Stuessy* 342 (TEX); 40 mi S of Zimatlán, 13 Aug 1966, *Stuessy* 645 (TEX). PUEBLA: just SE of the Morelos-Puebla border on rte 115, 19 Jun 1960, *King* 2917 (DS, NY, TEX, UC, US); Asunción de Chila, 25 Aug 1965, *Stuessy* 345 (TEX). QUERÉTARO: 2 mi W of Landa, 13 Dec 1960, *Crutchfield & Johnston* 6120b (TEX). QUINTANA ROO: Coba, Jun-Jul 1938, *C. & A. Lundell* 7879 (US). SAN LUIS POTOSÍ: ca 10 mi S of Tamazunchale, 23 Mar 1961, *King* 4239 (F, NY, TEX, UC, US); Cardenas, 3 Nov 1891, *Pringle* 3923 (DS, F, GH, NY, UC [2], US); 2 mi off rte 80 on rd to Quadalcazar, 10 Aug 1965, *Stuessy* 282 (TEX). SINALOA: ca 15 mi N of

Rosario, 13 Aug 1960, *King* 3711 (DS, NY, RSA, TEX, UC); 4.5 mi N of Escuinapa, 4 Sep 1965, *Stuessy* 403 (TEX). TABASCO: 57 mi SE of Coatzacoalcos, 17 Jul 1966, *Stuessy* 527 (TEX); 84 mi E of Coatzacoalcos, 17 Jul 1966, *Stuessy* 528 (TEX); 5 mi W of Villa Hermosa, 23 Jul 1966, *Stuessy* 547 (OS, TEX); 37 mi S of Villa Hermosa, 23 Jul 1966, *Stuessy* 548 (TEX). TAMAULIPAS: ca 4-5 mi W of Ciudad Mante, 18 Feb 1961, *King* 3833 (F, NY, TEX, US); 4 mi S of Juamave, 6 Jul 1949, *Stanford, Taylor & Lauber* 2313 (DS, GH, NY, RSA, SMU, TEX, UC, US [2]); 1 mi E of Gómez Farías, 8 Jul 1967, *Stuessy* 829 (TEX). VERACRUZ: ca 25 mi SE of Poza Rica, 10 Mar 1961, *King* 4138 (F, NY, TEX, US); 23.2 mi SE of Alvarado, 21 Aug 1965, *Stuessy* 318 (TEX); 12 mi S of Tantoyuca, 6 Jul 1966, *Stuessy* 473 (TEX); 49 mi SE of Catemaco, 16 Jul 1966, *Stuessy* 526 (TEX). YUCATÁN: Izamal, 1895, *Gaumer* 563 (F, GH [2], NY [2], US); Progreso, 20 Jul 1966, *Stuessy* 543 (TEX). **Nicaragua.** CHINANDEGA: vicinity of Chichigalpa, 12-18 Jul 1947, *Standley* 11226 (F). GRANADA: Volcán Mombacho, 20 Feb 1903, *Baker* 2482 (GH, POM, UC, US); NE limits of Granada, 6 Aug 1966, *Stuessy* 620 (TEX). MANAGUA: 1 mi SE of Managua, 5 Aug 1966, *Stuessy* 616 (TEX); 5 mi E of Managua, 6 Aug 1966, *Stuessy* 621 (TEX). MASAYA: near Masaya, SW slopes of Santiago Volcano, 5 Jul 1923, *Maxon* 7694 (US). MATAGALPA: Sebaco, 5 Aug 1966, *Stuessy* 614 & 615 (TEX). PUNTARENAS: 21 km SE of Puntarenas, 20 Aug 1938, *Stork & Morrison* 8920 (GH, UC). **Panama.** CANAL ZONE: vicinity of Frijoles, 9 Jul 1962, *King* 5226 (UC, US). DARIÉN: trail between Pinogana & Yavisa, 17 Mar 1937, *Allen* 241 (GH [3], NY, US). PANAMÁ: near Arraiján, 21 Jul 1938, *Woodson, Allen & Seibert* 1370 (GH, NY, US). PEARL ARCHIPELAGO: San José Is, Naval Station, 22 Jul 1945, *Erlanson* 500 (DS, GH, TEX, US). **Puerto Rico:** Mayaguez, 14-15 Feb 1914, *Britton & Cowell* 1561 (NY). **Virgin Islands.** ST. CROIX: near Mt Pleasant, 19 Aug 1896, *Ricksecker* "S" (F, NY).

27. **Melampodium costaricense** Stuessy, Brittonia 22:118. *f. 7.* 1970. TYPE: COSTA RICA: Alajuela, Naranjo, Cerro del Espíritu Santo, 1200 m, 11 Jul 1941, *A. Smith* 2922 (Holotype, F!).

Annual herbs, 15-35 cm tall. Stems erect, with lateral stems often decumbent, 0.8-4 mm diam, glabrous to tomentose with hairs 0.3 mm long. Peduncles 0.5-7 cm long. Leaves with petioles 4-25 mm long, ovate-rhombic (younger leaves approaching lanceolate), 2.5-7 cm long, 1.5-5.5 cm wide, at apex acuminate to obtuse, at base obtuse-attenuate, with upper surface infrequently strigose with hairs 0.6 mm

long, with lower surface glabrous; margin obscurely to coarsely serrate. Heads 4-5 mm tall, 6-7 (10) mm diam. Outer involucre cupulate, 5-10 mm diam; bracts 5, connate 1/3-1/4 their length, imbricate, ovate-orbiculate, 2.2-5 mm long, 2-4 mm wide, at apex obtuse, with abaxial surface glabrous; margin herbaceous, ciliate with hairs 0.3 mm long. Fruits 2.9-3.1 mm long, with lateral surfaces with diagonal ridges and enlarged margins. Ray florets 5-8; ligules yellow-orange, elliptic, 1-1.5 mm long, 0.5-1 mm wide. Disc florets 15-25; corollas yellow, 1.1 mm diam, with throat 0.8 mm and tube 0.5 mm long. Paleae oblong-elliptic, 2 mm long, 0.7 mm wide; apex yellow, with margin erose; midrib weak, glabrous. Chromosome number, $n = 25 \pm 1$.

Tropical habitats in British Honduras, Nicaragua, Costa Rica and Panama of Central America, and Colombia, South America (Fig. 25), 0-1980 m. Flowering dates, Jan-Dec.

REPRESENTATIVE SPECIMENS. **British Honduras.** EL CAYO: El Cayo, Jun-Aug 1936, *Lundell* 6107 (F, GH, NY, US). **Colombia.** CUNDINAMARCA: Caqueza to Río Sananie, 24 Aug 1917, *Pennell* 1335 (NY). **Costa Rica.** ALAJUELA: banks of the Río Rosales y Carret, 8 Dec 1933, *Brenes* 17471 (NY); San Pedro de San Ramón, 29 Jul 1935, *Brenes* 20572 (F). CARTAGO: above Tres Ríos, 19 Mar 1965, *Godfrey* 67156 (FSU); Turrialba, Instituto Interamericano de Agrícolas, 20 Aug 1962, *King* 5348 (TEX, UC, US); Finca Las Concavas, 7-8 Dec 1925, *Standley* 41531 (US); rr below Turrialba, 9 Jun 1928, *Stork* 2486 (F, US). GUANACASTE: Hatillo, 4 Jan 1935, *Solís* 56 (F). LÍMON: marshes of Suerre & Dos Bocas, 3 Oct 1951, *Shank & Molina* 4236 (F, GH); Hamburg Finca, on the Río Reventazon below Cairo, 19 Feb 1926, *Standley & Valerio* 48814 (US). SAN JOSÉ: Alajuelita, 8 Sep 1946, *Echeverría* 628 (F); San Isidro, 26 Feb 1965, *Godfrey* 6664 (FSU); San Pedro de Montes de Oca, 2 Aug 1938, *Orozco* 294 (F); El General [San Isidro del], Jan 1939, *Skutch* 3968 (GH, K, NY, US); between San Pedro de Montes de Oca & Curridabat, 2 Feb 1924, *Standley* 32757 (US); San José, Feb 1924, *Standley* 39021 (US). **Nicaragua.** GRANADA: near Granada, 1845-48, *Oersted* 9010 (photograph of K specimen, US). **Panama.** BOCAS DEL TORO: Changuinola Valley, 15 Mar 1924, *Dunlap* 557 (F, US). CHIRIQUI: 25 mi N of Concepción, 29 Jul 1962, *King* 5290 (TEX, UC, US).

28. **Melampodium dicoelocarpum** Robins. Proc. Amer. Acad. Arts & Sci. 44:619. 1909. TYPE: MEXICO: Guerrero, El Cala-

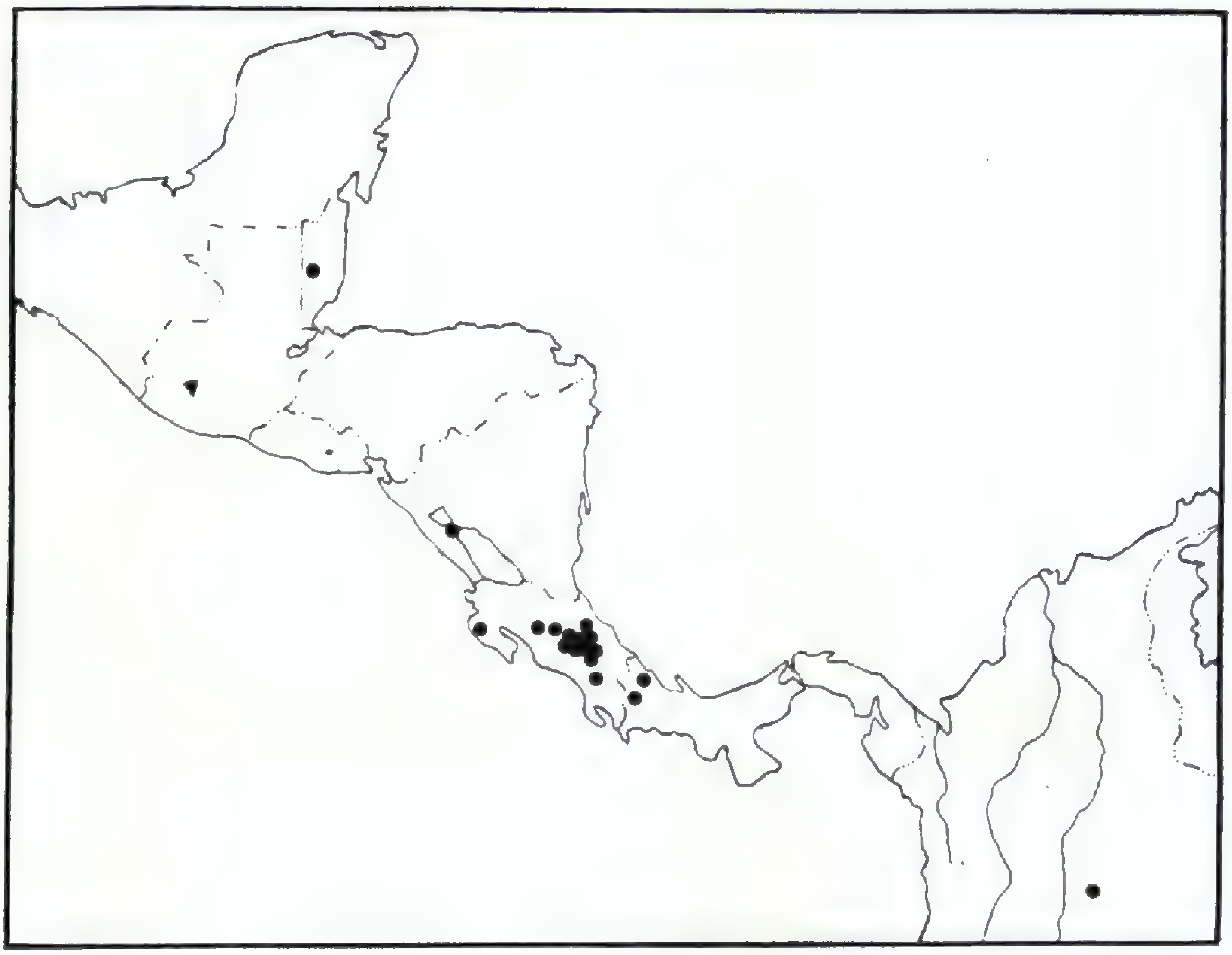

Fig. 25. Map of Central America and neighboring countries showing distribution of *Melampodium costaricense.*

bazal, 300 m, 20 Oct 1898, *E. Langlassé* 482 (Holotype, GH!; isotypes, G! K! P! US!; photograph of K isotype, US!; photograph of US isotype, TEX!).

Annual herbs, 10-50 cm tall. Stems erect, 0.6-1.6 mm diam, glabrous to moderately pilose with hairs 0.3-1.3 mm long. Peduncles deflected, 0.4-7.5 cm long. Leaves with petioles 2-10 mm long, ovate to somewhat deltoid (younger leaves often ovate-lanceolate), 2-6 cm long, 0.7-3 cm wide, at apex acuminate-attenuate, at base obtuse-attenuate, with both surfaces moderately pilose with hairs 1 mm long; margin obscurely to coarsely serrate. Heads 2-4 mm tall, 2.5-8 mm diam. Outer involucre spreading, 2-7 mm diam; bracts 5 (rarely 3 or 4), slightly connate at base, separate, ovate-lanceolate, 1.5-4.5 mm long, 1-2.5 mm wide, at apex acuminate, with abaxial surface moderately strigose with

hairs 0.6-1 mm long; margin herbaceous. Fruits 1.7-3 mm long, with lateral surfaces with 2 deep oval depressions. Ray florets 3-5; ligules yellow-orange, oblong-elliptic, 2.2-2.5 mm long, 1.2-1.8 mm wide. Disc florets 25-35; corollas yellow-orange, 0.8 mm diam, with throat 0.7 mm and tube 0.5 mm long. Paleae oblong-elliptic, 2 mm long, 0.7 mm wide; apex yellow, with margin erose to laciniate; midrib weak, glabrous. Chromosome numbers, $n = 12$ and 23.

Tropical deciduous forests in the Mexican states of Jalisco, Michoacán, Guerrero and México (Fig. 13), 200-1890 m. Flowering dates, Jun-Oct.

The cytological vouchers for the two chromosome levels are morphologically distinguishable, the aneuploid at the tetraploid level being larger in most characters. However, without intensive field and garden studies, it seems premature to propose formal recognition of these forms.

Among all the taxa of *Melampodium*, *M. dicoelocarpum* can be distinguished easily by the two deep oval cavities on the lateral sides of the fruit.

REPRESENTATIVE SPECIMENS. **Mexico.** GUERRERO: Mina, Zihuagio, 17 Oct 1936, *Hinton* 9714 (G, GH, MICH, NY, P, UC, US); Galeana, Atoyac-San Juan, 12 Oct 1939, *Hinton et al.* 14614 (ARIZ, F, GH, NY, US). JALISCO: Tecalitlán, Barranca de San Juan de Díos, ca 15 km E of Pihuamo, 24 Oct 1963, *Feddema* 2204 (MICH). MÉXICO: Temascaltepec, Anonas, 24 Jun 1934, *Hinton et al.* 6334 (GH, MICH, NY). MICHOACÁN: ca 5 mi N of Cotija, 5-9 Oct 1961, *King & Soderstrom* 4646 (MICH, NY, SMU, TEX, UC, US); 25 mi S of Ario de Rosales, 20 Aug 1966, *Stuessy* 693 (TEX); 15 mi S of jct rte 15 on rd to Cotija, *Stuessy* 715 (TEX).

29. **Melampodium tepicense** Robins. Proc. Amer. Acad. Arts & Sci. 44:620. 1909. TYPE: MEXICO: Nayarit, Tepic, 5 Jan-6 Feb 1892, *E. Palmer* 1814 (Holotype, GH!; isotypes, F! NY! US!).

Melampodium cornutum S. F. Blake, Jour. Wash. Acad. Sci. 16:421. 1926. TYPE: MEXICO: Colima, Alzada,4 Nov 1910, *C. R. Orcutt* 6601 (Holotype, US!; photograph of holotype, TEX!).

Annual herbs, 7-35 cm tall. Stems decumbent to erect, 0.5-1.3 mm diam, mostly glabrous to puberulent with hairs 0.1 mm long. Peduncles 0.8-8 mm long. Leaves with narrowly marginate petioles 1-18 mm long, ovate to rhombic, 0.8-5.7 cm long, 0.7-3.5 cm wide, at apex acute, at base attenuate to obtuse, with both surfaces sparsely strigose with hairs 0.3-1 mm long; margin crenate to serrate, near base entire. Heads 2-3 mm tall, 3-5 mm diam. Outer involucre cupulate, 3.5-7 mm diam; bracts 5, slightly connate at base, separate, elliptic, 2-4 mm long, 1.2-2.2 mm wide, at apex obtuse, with abaxial surface glabrous; margin herbaceous. Fruits 1.6-2 mm long, with lateral surfaces tuberculate to aculeate-reticulate; apex with a flattened abaxial appendage[15], with tapering cirrhous awn up to 4 mm long. Ray florets 3-7; ligules pale-yellow, ovate-oblong, 0.8-1.5 mm long, 0.4-0.8 mm wide. Disc florets 3-7(12); corollas yellow-green, 0.8 mm diam, with throat 0.4 mm and tube 0.7 mm long. Paleae oblong-oblanceolate, 1 mm long, 0.5 mm wide; apex pale-yellow, with margin irregularly dentate; midrib weak, glabrous. Chromosome number unknown.

Pine-oak and tropical deciduous forests in Nayarit, Jalisco, Colima, and Michoacán, Mexico (Fig. 18), 100-1740 m. Flowering dates, Aug-Feb.

Recent collections from Nayarit, Mexico, show much variation and intergradation in the leaf and inner involucral bract characters used by Blake (1926) to separate *M. tepicense* from *M. cornutum*. In my opinion they are conspecific.

REPRESENTATIVE SPECIMENS. **Mexico.** COLIMA: SW foothills of Nevado de Colima, 1-1.5 mi S of Hacienda San Antonio, 11 Aug 1957, *McVaugh* 16112 (MICH). JALISCO: ca 10 km NE of Puerto Vallarta near Milagro on rd to Mascota, 15 Nov 1963, *Feddema* 2577 (MICH); 10 mi S of Autlán, 19 Aug 1949, *R. & C. Wilbur* 2416 (MICH). MICHOACÁN: Coalcomán, Parotas, 28 Sep 1938, *Hinton et al.* 12276 (MICH, NY, UC, US). NAYARIT: 10 mi SE of Ahuacatlán on rd to Bar-

[15]Similar to the appendage in *M. longipilum*, except here in *M. tepicense* it is on the abaxial rather than the adaxial side of the achene apex.

ranca del Oro, 11-12 Aug 1959, *Feddema* 279 (MICH); 1 km N of El Cuatante, ca 40 km NNE of Puerto Vallarta, 18 Nov 1963, *Feddema* 2651 (MICH); 8 mi W of Tepic, 10 Sep 1960, *McVaugh* 18906 (MICH); 9 mi N of Compostela, 12 Nov 1959, *McVaugh & Koelz* 542 (MICH).

30. **Melampodium sinaloense** Stuessy, Brittonia 22:122. *f. 10.* 1970. TYPE: MEXICO: Sinaloa, Quebrado de Mansana, Sierra Surotato, 4000-4500 ft, 10-14 Sep 1941, *H. S. Gentry* 6507-A (Holotype, GH!; isotypes, ARIZ! DS! MICH! MO! NY!).

Annual herbs, 25-35 cm tall. Stems decumbent, 1-2 mm diam, sparsely tomentose to moderately hispidulous with hairs 0.1-0.3 mm long. Peduncles 1-2.9 cm long. Leaves with petioles 10-15 mm long, ovate, 3.5-5 cm long, 2-2.5 cm wide, at apex acute, at base attenuate, with both surfaces sparingly strigose with hairs 0.3-1.2 mm long; margin serrate. Heads 3-4 mm tall, 3-4 mm diam. Outer involucre cupulate, 5-10 mm diam; bracts 5, slightly connate at base, separate, narrowly elliptic to elliptic, 2.5-6 mm long, 1.2-1.5 mm wide, at apex obtuse, with abaxial surface with 2-5 hairs 0.3 mm long on midrib and major lateral veins; margin herbaceous. Fruits 1.8-2 mm long, with lateral surfaces ridged. Ray florets 6; ligules pale-yellow, elliptic, 1.5-2 mm long, 1-1.2 mm wide. Disc florets ca 14; corollas pale-yellow, 0.8 mm diam, with throat 0.7 mm and tube 0.6 mm long. Paleae elliptic, 1.3 mm long, 0.6 mm wide; apex pale-yellow, with margin irregularly and weakly dentate; midrib weak, glabrous. Chromosome number unknown.

Known only from the type collection from oak forests in Sinaloa, Mexico (Fig. 18), 1220-1370 m. Flowering date, Sep.

IV. **Melampodium** section **Bibractiaria** Stuessy, sect. nov.

Herbae annuae radicibus palaribus; folia ovata vel obovata, sessilia vel subsessilia, marginibus integris; involucrum extimum cupulatum, bracteis 2, marginibus herbaceis vel leniter scariosis; ovaria flosculi disci ovoidea, minus quam 0.7 mm longa, rudimentales (Figs. 3 & 4); fructus apice fere laeves vel moderate sculpti et sine cucullis;

chromosomatum numerus basicus ignotus. Species 31 & 32. Typus: *Melampodium bibracteatum* S. Wats.

31. **Melampodium bibracteatum** S. Wats. Proc. Amer. Acad. Arts & Sci. **26**:140. 1891. TYPE: MEXICO: México, Del Río [ca 13 mi N of Toluca], 30 Aug 1890, *C. G. Pringle* 3230 (Holotype, US!; isotypes, DS! F! G[2]! GH! MA! MO! MSC! NY [2]! P! UC! US! W!; photograph of holotype, TEX!; photograph of K isotype, US!).

Annual herbs, 2-32 cm tall. Stems ascending to decumbent, 1.8-3.5 mm diam, glabrous below to pubescent above with hairs 0.2 mm long. Peduncles 0-3.5 mm long (heads often sessile). Leaves sessile, with blades oblong to obovate or oblanceolate, 0.9-4 cm long, 0.3-1.8 cm wide, at apex obtuse-acute, at base obtuse-subauriculate to somewhat connate, with both surfaces with a conspicuous midrib (very large basally) extending 1/3-1/2 of blade, with upper surface glabrous, with lower surface subglabrous; margin entire to 6-lobed, moderately ciliate with hairs 0.1 mm long. Heads 3.5-4.5 mm tall, 3.5-4.8 mm diam. Outer involucre cupulate, 4-7 mm diam; bracts 2, separate, ovate, 3-4.2 mm long, 1.5-2.5 mm wide, at apex acute, with abaxial surface glabrous; margin herbaceous to weakly scarious, rarely with several hairs 0.2-0.5 mm long. Fruits 2-2.7 mm long, with lateral surfaces smooth with several conspicuous nerves. Ray florets (3-) 5-6; ligules yellow, elliptic-ovate, 1 mm long, 0.4 mm wide. Disc florets 4; corollas yellow, 0.8 mm diam, with throat 0.7 mm and tube 0.5 mm long. Paleae oblanceolate, 1.5 mm long, 0.6 mm wide; apex colorless, with margin irregularly laciniate; midrib very weak, glabrous. Chromosome number unknown.

Mainly in low, moist areas in pine-oak forests of central Mexico (Hidalgo, México and Puebla) but populations occur also in southwestern Durango and in Guatemala (Fig. 20), 2140-3360 m. Flowering dates, Aug-Oct.

REPRESENTATIVE SPECIMENS. **Guatemala.** HUEHUETENANGO: Sierra de los Cuchumatanes, 1.5 mi W of Llano de San Miguel on trail to Todos Santos, 2 Aug 1960, *Beaman* 3977 (GH, TEX, UC). **Mexico.**

DURANGO: 10 mi W of El Salto, 2 Oct 1962, *Cronquist* 9585 (NY); 3 mi SW of El Salto, 12 Aug 1961, *Waterfall* 16198 (SMU); 57 mi SW of Durango, 13 Aug 1957, *Waterfall & Wallis* 13702 (SMU, US). HIDALGO: near Buena Vista Station, 10 Aug 1904, *Pringle* 13068 (ARIZ, F, GH, SMU, US). MÉXICO: Tultenango Station, 14 Sep 1901, *Pringle* 9301 (F, GH, K, NY, US); ½ mi W of Station Del Río, 18 Aug 1966, *Stuessy* 675 (TEX); 7 mi W of Toluca, 19 Aug 1966, *Stuessy* 676 (TEX). PUEBLA: near Cerro El Pinar, 28 Aug 1945, *Alexander & Hernández* 2229 [XA 218] (NY); Laguna de San Baltasar, vicinity of Puebla, 20 Sep 1966, *Arsène* 294 (US).

32. **Melampodium repens** Sessé & Moc. Fl. Mex. ed. 2. 193. 1894. TYPE: MEXICO: Veracruz, "Habitat in medietate Vulcani altissimi de Orizava," Jun 1795-1804, *M. Sessé et al.* "3981" (Holotype, MA!; photograph of holotype, OS! TEX!).

Melampodium arvense Robins. Proc. Amer. Acad. Arts & Sci. 36:464. 1901. TYPE: MEXICO: Distrito Federal, Valley of Mexico, 7500 ft, 19 Oct 1896, *C. G. Pringle* 7327 (Holotype, GH!; isotypes, F! POM! US!; photograph of US isotype, TEX!).

Annual herbs, 2-30 cm tall. Stems prostrate (often forming a mat), 0.8-1.8 mm diam, puberulent with hairs 0.2 mm long. Peduncles 0-3 mm long (heads often sessile). Leaves sessile or with petioles 2 mm long, obovate, 0.5-2.5 cm long, 0.3-1.6 cm wide, at apex acute-obtuse, at base attenuate-obtuse to somewhat connate, with both surfaces with a conspicuous midrib (very large basally) extending less than 1/3 of blade, with upper surface glabrous, with lower surface subglabrous; margin obscurely crenate, sometimes moderately ciliate with hairs 0.1 mm long. Heads 2-3 mm tall, 3.5-4 mm diam. Outer involucre cupulate, 4-5 mm diam; bracts 2, separate, ovate, 3.5 mm long, 1.8-2.2 mm wide, at apex acute, abaxial surface glabrous; margin herbaceous. Fruits 2-2.5 mm long, with lateral surfaces smooth with several conspicuous nerves. Ray florets 2-3; ligules yellow, elliptic-oblong, 0.8-1.2 mm long, 0.3 mm wide. Disc florets 6; corollas yellow, 0.5 mm diam, with throat 0.4 mm and tube 1.0 mm long. Paleae oblanceolate, 1.2 mm long, 0.4 wide; apex colorless, with margin laciniate; midrib very weak, glabrous. Chromosome number unknown.

Pine-oak forests in the Mexican states of Distrito Federal, México, Michoacán, and Veracruz (Fig. 20), 1380-3150 m. Flowering dates, Aug-Sep.

The two species of section *Bibractiaria* are perhaps the most unusual taxa of the whole genus, particularly in their over-all diminutive appearance. Chromosome counts have not been obtained yet from these two species, although collections have been made and counts attempted. In view of the wide diversity of chromosome numbers already found in *Melampodium*, it will be interesting to learn if new numbers may be obtained from these two taxa.

REPRESENTATIVE SPECIMENS. **Mexico.** DISTRITO FEDERAL: Cima, 24 Aug 1910, *Orcutt* 3780 (F); Eslava, Valley of Mexico, 7 Sep 1901, *Pringle* 8610 (ARIZ, F, G, GH, K, MSC, NY, POM, SMU, TEX, UC, US). DURANGO [?]: "in mountains near Santa Angela," Sep 1855, *Schaffner* s.n. (GH). MÉXICO: Parque Nacional de Laguna Zempoala, 26 Jul 1947, *Barkley, Webster & Rowell* 7438 (TEX); Temascaltepec, Cucha, 4 Sep 1933, *Hinton* 4628 (GH, NY, US); Temascaltepec, Tejupilco, 27 Sep 1933, *Hinton* 4826 (GH, K, NY, US); Toluca, 26 Sep 1892, *Pringle* 5257 (GH); Salto de Agua, Oct 1905, *Purpus* 1809 (F, UC); Popocatépetl, 22 Aug 1901, *Rose & Hay* 6244 (NY, US); Llano Grande, near Río Frio, 28 Jul 1944, *Sharp* 44116 (NY); 2 mi E of Cuajimalpa, 18 Aug 1966, *Stuessy* 670 (TEX). MICHOACÁN: SW side of Cerro San Andres, ca 12 km N of Ciudad Hidalgo, 6 Sep 1960, *Beaman* 4352 (GH). VERACRUZ: Loma Grande, 27 Aug 1938, *Balls & Gourlay* B5372 (K).

V. **Melampodium** section **Rhizomaria** Stuessy, sect. nov.

Plantae perennae rhizomatosae; folia anguste ovata vel oblonga, sessilia vel interdum sessilia, marginibus integris vel subintegris; involucrum extimum patens vel aliquantum cupulatum, bracteis 5, marginibus scariosis; ovaria flosculi disci ovoidea, minus quam 0.7 mm longa, rudimentales (Figs. 3 & 4); fructus apice fere laeves vel moderate sculpti et sine cucullis; chromosomatum numerus basicus, $x = 11$. Species 33 & 34. Typus: *Melampodium montanum* Benth.

33. **Melampodium montanum** Benth. Pl. Hartw. 64. 1840.

Suffrutescent perennials. Stems erect to ascending. Leaves usually sessile, ovate to elliptic, at apex obtuse

(rarely acute), at base obtuse to subauriculate. Outer involucre spreading or somewhat cupulate; bracts 5, connate 1/5 their length, imbricate, ovate, 4-5 mm long, 4-5 mm wide, at apex acute, with margin scarious. Fruits 1.6-1.8 mm long, with lateral surfaces smooth to nervose or marginally tuberculate. Ray florets 9-13; ligules yellow, narrowly elliptic-oblong. Disc florets 80-110; corollas yellow-green, with tube 0.8 mm long. Paleae oblanceolate, 2 mm long, 0.6 mm wide; apex yellow, with margin entire; midrib prominent, glabrous.

33a. **Melampodium montanum** Benth. var. **montanum**

Melampodium montanum Benth. Pl. Hartw. 64. 1840. TYPE: MEXICO: Oaxaca, "In summo jugo (Cumbre) inter Oaxaca et la Sierra," 1839, *C. T. Hartweg* 475 (Holotype, K!; photograph of holotype, OS! TEX! US!).

Melampodium liebmanii Sch. Bip. ex Klatt, Leopoldina 23:89. 1887. TYPE: MEXICO: Oaxaca, "Cumbre de Estepa et Yavesía," Jun 1842, *F. M. Liebmann* 232 (Lectotype, C; isotype, P!; photograph of lectotype, US!; photograph of C isotype, F! NY! US [2]!; photograph of P isotype, OS! TEX!; drawing and presumed fragment of lectotype, GH!).

Plants 6-28 cm tall. Stems 0.8-1.2 mm diam, copiously to sparsely villous with hairs 0.8-1.5 mm long. Peduncles 3-7.5 cm long. Leaves sessile or with petioles 1 mm long, 1.6-4 cm long, 0.8-1.7 cm wide, with both surfaces strigose with hairs 0.8 mm long; margin entire to obscurely denticulate. Heads 5-6 mm tall, 11-21 mm wide. Outer involucre 8-13 mm diam; bracts at apex purple-tinged, with abaxial surface villous with hairs 1 mm long. Ligules at apex and on veins on undersurface dark purple, 4-7.5 mm long, 1.5-2.5 mm wide. Disc florets 1 mm diam, with throat 1.4 mm long. Chromosome number, $n =$ ca 11.

Pine-oak forests in north-central Oaxaca, Mexico (Fig. 26), 1740-3360 m. Flowering dates, Jul-Aug.

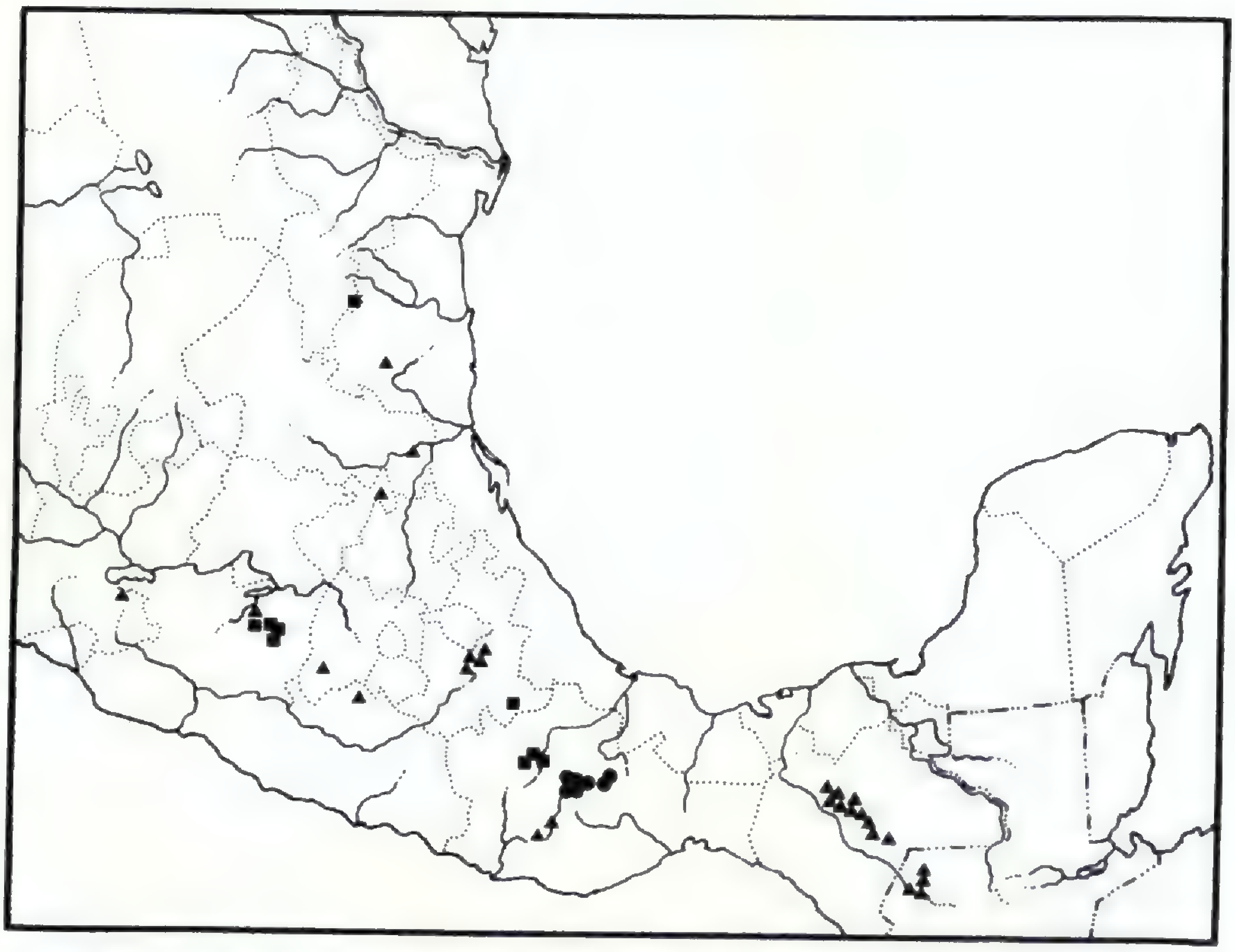

Fig. 26. Map of Mexico and adjoining Guatemala showing distribution of *Melampodium aureum* (squares), *M. montanum* var. *montanum* (dots), and *M. montanum* var. *viridulum* (triangles).

REPRESENTATIVE SPECIMENS. **Mexico.** OAXACA: Cerro San Felipe, 18 Aug 1921, *Conzatti* 4169 (US); Jul-Aug 1900, *Conzatti & González* 998 (GH); vicinity of Cerro Zempoaltepetl [Zempoaltepec], 10 Aug 1950, *Hallberg* 900 (US); ca 10 mi N of jct rtes 190 & 175, 26 Jul 1960, *King* 3492 (DS, NY, TEX, UC, US); NW side of summit of Mt Zempoaltepec, 9 Jul 1894, *Nelson* 655 (US); Sierra de San Felipe, 28 May 1894, *Pringle* 4666 (GH, US).

33b. **Melampodium montanum** Benth. var. **viridulum** Stuessy, var. nov.

Plantae 10-35 cm altae. Caules 0.8-1.4 mm diametro, villosi pilis 1-1.5 mm longis (raro glabri). Pedunculi 1-6.5 cm longi. Folia subsessilia (vel petiolis 2-3 mm longis), laminae 1.6-3.3 longae, 0.7-1.4 cm latae, utrinque strigosae vel moderate vilosae pilis 1-1.5 mm longis (subtus raro glabrae); margines integri. Capitula 4.5-6 mm alta, 12-17 mm diametro. Involucrum extimum 8-14 mm diametro; bracteae apice interdum purpurascentes, extus villosae pilis

1 mm longis (interdum subglabrae). Ligulae subtus apice venaque viridulae, 4-5 mm longae, 1.2-1.9 mm latae. Flosculi disci 0.8 mm diametro, faucibus 1.2 mm longis. Chromosomatum numerus, $n = 11$.

TYPUS: MEXICO: Chiapas, ca 5 mi E of San Cristóbal de Las Casas on rte 190, 11 Jun 1960, *R. M. King* 2801 (Holotype, US!; isotypes, DS! NY! TEX! UC!).

Scattered in pine-oak forests in several Mexican states in the Sierra Madres Oriental, Occidental and Sur, and including Chiapas and northwestern Guatemala (Fig. 26), 610-2740 m. Flowering dates, Jun-Oct.

REPRESENTATIVE SPECIMENS. **Guatemala.** HUEHUETENANGO: Sierra de los Cuchumatanes, between kms 324 & 325 on rte 9N (between Chemal & San Juan Ixcoy), 4 Aug 1959, *Beaman* 3043 (GH, NY, UC); San Pedro Coloma, 20 Aug 1934, *Skutch* 1036 (F, GH, US); SW slopes of Sierra de los Cuchumatanes, between Chiantla & Patio de Bolas, 6 Jul 1942, *Steyermark* 48234 (F); along Río Selegua, opposite San Sebastián H., 13 Aug 1942, *Steyermark* 50490 (F, GH). **Mexico.** CHIAPAS: Jitotol, 3 mi S of Jitotol, 12 Feb 1965, *Breedlove* 8906 (DS); Tenejapa, Tuk, Matsab, 30 Sep 1965, *Breedlove* 12522 (DS); Comitán, 30 Apr 1904, *Goldman* 914 (US); ca 17 mi W of San Cristóbal de Las Casas, 9 Jun 1960, *King* 2796 (DS, NY, TEX, UC, US); ca 1 mi E of Teopisca, 12 Jun 1960, *King* 2843 (TEX); San Cristóbal de Las Casas, Cerro San Cristóbal, 11 Jun 1966, *Laughlin* 1050 (DS); Amatenango del Valle, 12 Jun 1945, *Matuda* 6002 (F); 34 mi S of Ishuatán on gravel rd to Tuxtla Gutiérrez, 24 Jul 1966, *Stuessy* 559 (TEX); 20 mi S of San Cristóbal, 25 Jul 1966, *Stuessy* 566 (TEX); 8 mi S of San Cristóbal, 25 Jul 1966, *Stuessy* 567 (TEX); 2 mi SE of Teopisca, 25 Jul 1966, *Stuessy* 568 (TEX); 9 mi SE of Teopisca, 25 Jul 1966, *Stuessy* 570 (TEX). GUERRERO: Taxco, 23 Jul 1936, *Abbott* 162 (GH). JALISCO: Sierra del Tigre, 3 mi S of Mazamitla, 18 Sep 1952, *McVaugh* 13033 (SMU, US). MÉXICO: Temascaltepec, Bejucos, 7 Oct 1932, *Hinton* 2017 (ARIZ, F, MA, NY [2], US). MICHOACÁN: Morelia, Cerro Azul, 1910, *Arsène* 6575 (US). OAXACA: 15 km S of Sola de Vega, on rd to Puerto Escondido, 30 Sep 1965, *Rzedowski* 21322 (TEX). PUEBLA: vicinity of Puebla, woody hill farther than Cerro Tepoxuchitl, 16 Sep 1907, *Arsène* 1896 (GH, NY, US); hills near Amozoc, 10 Sep 1901, *Pringle* 9361 (F, GH, US). QUERÉTARO: 8 km W of El Lobo, municipio de Landa, 31 Aug 1957, *Rzedowski* 9320 (ENCB). SAN LUIS POTOSÍ: "barranca of Las Canoas," 18 Aug 1891, *Pringle* 3818 (DS, F, GH [2], NY [2], UC [2], US). TAMAULIPAS: Gómez Farías Region, between Rancho del Cielo & Charco de los Perros, spring 1965, *Webster* 140 (TEX).

34. **Melampodium aureum** Brandg. Univ. Calif. Pub. Bot. 4:94. 1910. TYPE: MEXICO: Puebla, Cerro de Gavilán, 8000-9000 ft, Aug 1909, *C. A. Purpus* 3822 (Holotype, UC!; isotypes, F! G! GH! MO! NY! US!; photograph of US isotype, TEX!).

Suffrutescent perennials, 10-35 cm tall. Stems erect to ascending (occasionally decumbent), 0.8-2 mm diam, moderately villous with hairs 0.5-1 mm long. Peduncles 4.5-11.5 cm long. Leaves usually sessile or with petioles 2-3 mm long, ovate to weakly spatulate, 2.7-6 cm long, 1-2.7 cm wide, at apex obtuse to acute, at base obtuse to subauriculate, with both surfaces strigose with hairs 0.5-0.8 mm long; margin entire to serrulate, ciliate with hairs 0.3 mm long. Heads 6-7 mm tall, 19-38 mm diam. Outer involucre spreading or somewhat cupulate, 10-14 mm diam; bracts 5, connate 1/5 their length, imbricate, ovate, 4-6 mm long, 3.5-6 mm wide, at apex acute and sometimes purple-tinged, with abaxial surface villous with hairs 0.5 mm long (sometimes mostly glabrous); margin scarious. Fruits 2-2.3 mm long, with lateral surfaces smooth to rugose-aculeate. Ray florets 11-14; ligules yellow-orange to yellow, narrowly elliptic-oblong to oblanceolate, 5-13 mm long, 2-3 mm wide. Disc florets 80-110; corollas yellow, 1 mm diam, with throat 1.8 mm and tube 0.7 mm long. Paleae oblanceolate, 3.2 mm long, 0.6 mm wide; apex yellow, with margin entire; midrib prominent, glabrous. Chromosome number, n = 33.

Scattered in pine-oak forests in Nuevo León, Michoacán, Oaxaca, and Puebla, Mexico (Fig. 26), 1800-2500 m. Flowering dates, Jul-Sep.

The morphology of the hexaploid *M. aureum* suggests that it may have been derived from the diploid *M. montanum* by autopolyploidy, perhaps through the union of unreduced gametes from diploid and tetraploid plants. The two taxa are so similar, in fact, that experimental studies may indicate that *M. aureum* should be treated as simply a polyploid race of *M. montanum*. The extant chromosomal voucher specimens, however, do show a considerable amount

of morphological divergence albeit of a quantitative nature. In view of these morphological differences and in the absence of intensive field and laboratory studies, I prefer to maintain the two taxa as distinct species at the present time.

REPRESENTATIVE SPECIMENS. **Mexico.** MICHOACÁN: vicinity of Morelia, Cerro San Miguel, 15 Sep 1910, *Arsène* 5219 (GH, NY, US); ca 20 mi W of Ciudad Hidalgo, 4 Aug 1960, *King* 3617 (DS, NY, TEX, UC, US); 23 mi NW of Ciudad Hidalgo, 19 Aug 1966, *Stuessy* 682 (TEX); 21 mi NW of Ciudad Hidalgo, 19 Aug 1966, *Stuessy* 684 (TEX). NUEVO LEÓN: Dulces Nombres, 20 Jul 1948, *Meyer & Rogers* 2828 (US), 10 Aug 1948, 2911 (US). OAXACA: Nochistlán, Cuesta Blanca, rd to Montelobos, 22 Jun 1907, *Conzatti* 1865 (F); ca 8 mi SE of Nochistlán, 27 Jul 1960, *King* 3529 (DS, NY, TEX, UC, US); 7 mi SE of Nochistlán, 15 Aug 1966, *Stuessy* 663 (TEX). PUEBLA: Cerro del Oro, Aug 1909, *Purpus* 3822a (F, GH, NY, UC, US).

VI. **Melampodium** section **Alcina** (Cav.) DC.

Melampodium L. sect. *Alcina* (Cav.) DC. Prodr. 5:520. 1836. *Alcina* Cav. Ic. 1:10. *t. 15.* 1791. Type species: *Melampodium perfoliatum* (Cav.) H.B.K.

Tap-rooted annuals; leaves ovate or oblong, sessile or petiolate, with margins entire or weakly serrate; outer involucre spreading, with bracts 3-5, at margins herbaceous; ovaries of the disc florets ovoid, less than 0.7 mm long, rudimentary (Figs. 3 & 4); fruits at apex nearly smooth or moderately sculptured and without hoods; chromosome base number, $x = 11$. Species 35-37.

35. **Melampodium perfoliatum** (Cav.) H.B.K. Nov. Gen. Sp. 4:274. 1820.

Alcina perfoliata Cav. Cav. Ic. 1:11. *t. 15.* 1791. TYPE: "IMPERIO MEXICANO": cultivated in Bot. Gard. Madrid, flowering 29 Nov (Lectotype chosen, MA!; isotypes, MA [2]!; photograph of lectotype, OS! TEX!).

Wedelia perfoliata (Cav.) Willd. Sp. Plant. 3(3):2335. 1803.

Polymnia perfoliata (Cav.) Poiret, Encycl. Méthod. Botan. 5:506. 1804.

Camutia perfoliata Bonato ex Steud. Nom. Bot. 146. 1821. *pro syn.*

Melampodium connatum Sessé & Moc. ex DC. Prodr. 5:521. 1836. *pro syn.*

Polymnia revoluta Autor. ex Steud. Nom. Bot. ed. 2. 2: 377. 1841. *pro syn.*

Annual herbs, 20-150 cm tall. Stems erect, 1-11 mm diam, glabrous below to very minutely puberulent above. Peduncles 0.6-11 cm long. Leaves sessile, rhombic-deltoid (rarely ovate-obovate) and tapering to an auriculate-connate base (sometimes obtuse on upper leaves), 2-21 cm long, 0.9-15 cm wide, at apex acute, with both surfaces strigose with hairs 0.2-0.3 mm long; margin obscurely to strongly irregularly serrate. Heads 5-7 mm tall, 8-11 mm diam. Outer involucre spreading, 15-32 mm diam; bracts 5, slightly imbricate and connate at base, oblong-elliptic, 6-20 mm long, 4-11 mm wide, at apex obtuse, with abaxial surface occasionally strigose with hairs 0.2-0.5 mm long; margin herbaceous. Fruits 4-7 mm long, with lateral surfaces smooth to moderately striate or nervose. Ray florets 8-13; ligules yellow-orange, oblong-elliptic, 2.5-4 mm long, 0.9-2.3 mm wide. Disc florets 30-45; corollas yellow, 1.5 mm diam, with throat 1 mm and tube 0.8 mm long. Paleae oblong-elliptic, 2.1 mm long, 0.7 mm wide; apex light yellow, with margin dentate-laciniate; midrib distinct, glabrous. Chromosome numbers, $n = 11$ & 12.

Tropical deciduous and pine-oak forests in Mexico, Guatemala, and Costa Rica, introduced to Cuba and Los Angeles, California (Fig. 27), 610-2440 m. Flowering dates, Jan-Dec.

M. perfoliatum is the second most widely spread species in the genus (after *M. divaricatum*), but apparently it has been introduced only at one point in the United States (near Los Angeles). Because the city of Los Angeles and surrounding suburbs have grown tremendously in the last

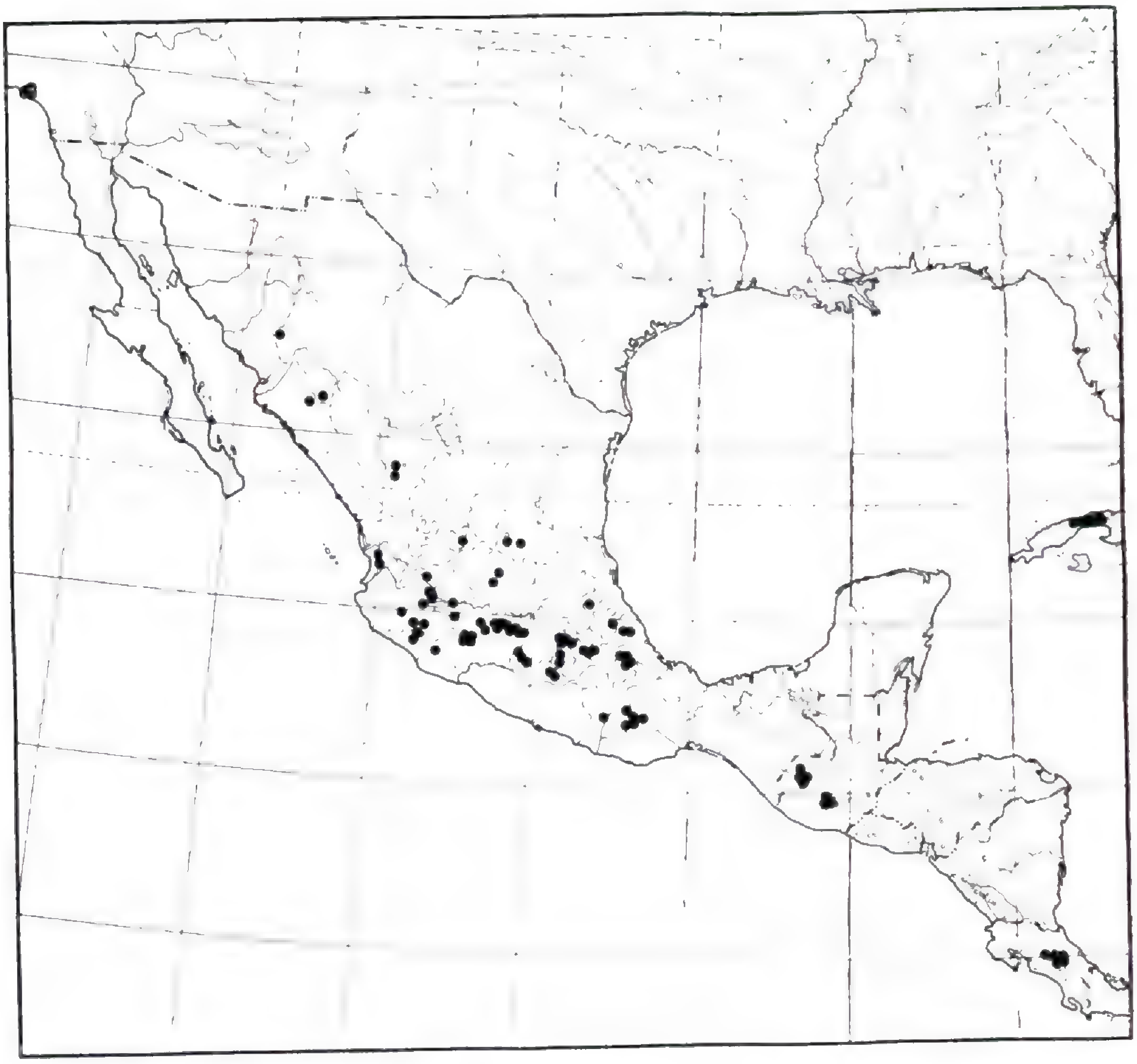

Fig. 27. Map of Mexico, Central America and neighboring countries showing distribution of *Melampodium perfoliatum*.

60 years, it is likely that *M. perfoliatum*, however weedy and aggressive, has not managed to survive. Specimens examined from Los Angeles Co., California, support this contention, as there are no records later than 1902.

At maturity *M. perfoliatum* is very easy to recognize because the large fruits remain temporarily in a conspicuous ring within the spreading foliaceous outer phyllaries. In the field the bases of the lower leaves are markedly perfoliate and also help distinguish the species. On herbarium specimens, however, this latter characteristic is less helpful because the bases of the upper leaves are sometimes obtuse, and such leaves, due to their more convenient size, most frequently are selected and pressed by collectors.

An interesting nomenclatural problem is associated with the earliest date of publication for the combination *Melampodium perfoliatum.* It has generally been attributed to H.B.K. in 1820. An anonymous author (perhaps M. A. Valdes, *fide* Langman, 1964) in the Gazeta de México of 1792-93 (vol. 5, p. 243) reported the events taking place at a public botanical examination in La Real y Pontífica Universidad in Mexico City on December 7, 1792. At this gathering a student, Sebastián Gómez Moron, read a paper in which he ". . . determinó y describió con la mayor propiedad el Melampodio reunido, o *Melampodium perfoliatum.* . . ." A footnote elaborates in some detail the circumstances surrounding this new combination which precedes that of H.B.K. by at least 27 years. According to the anonymous author, it was the "opinión" of the "Expedición" (i.e., Sessé, Castillo, and Mociño) traveling through Mexico, that *Alcina perfoliata* of Cavanilles should not be generically separated from the well-known *Melampodium.* The student, Gómez Moron, apparently looked into the matter more closely and agreed with this contention. The author adds another sentence in the footnote, however, that changes the nomenclatural complexion of the situation: "Los Botánicos que tuvieren ocasion de cotejar la Planta, ó la exacta descripcion de este autor [Cavanilles] con qualquiera de los Melampodios conocidos, pesarán los fundamentos que median entre una y otra parte, y fixarán el nombre con que debe conocerse en lo sucesivo esta nueva especie." The author states that botanists who might compare the species with the existing taxa of *Melampodium* will have to weigh the facts and decide what the correct name *should be.* I interpret this hesitation to mean that the author did not accept the new combination at this time, which therefore precludes its validation (Article 34, Provisions 1 and 2, Intern. Code Bot. Nomen.; Lanjouw et al., 1966).

REPRESENTATIVE SPECIMENS. **Costa Rica.** ALAJUELA: between San Josecito & La Garita, 18 Aug 1963, *Jiménez* 1074 (F). CARTAGO: vicinity of Turrialba, 5 Feb 1965, *Godfrey* 66184 (FSU); Turrialba,

Instituto Interamericano de Agrícolas, 20 Aug 1962, *King* 5350 (TEX, UC, US); 4 km E of Cartago, 28 Aug 1962, *King* 5407 (TEX, UC, US). SAN JOSÉ: Río Torres, San José, 31 Jan 1965, *Godfrey* 66064 (FSU). **Cuba.** LA HABANA: Santiago de las Vegas, 30 Jun 1904, *Baker & Wilson* 516 (F, NY, UC, US); Laguna de Ariguanabo at Cayo La Rosa, 17 Jul 1923, *Ekman* 16932 (NY); Santiago de las Vegas, 10 Oct 1904, *Hermann* 148 (F, NY, US); Laguna de Castellano, 27 Dec 1910, *Wilson* 9553 (NY [2]). PINAR DEL RÍO: near Potrerito, Sumidero, 19 May 1951, *Alain* 1819 (NY). **Guatemala.** GUATEMALA: city limits of Guatemala, 9 Jul 1960, *King* 3248 (DS, NY, TEX, UC, US); Guatemala City, 1 Aug 1966, *Stuessy* 603 (TEX). HUEHUETENANGO: ca 1 mi S of Huehuetenango, 18 Jul 1960, *King* 3410 (DS, NY, TEX, UC, US); 2 mi S of Huehuetenango, 26 Jul 1966, *Stuessy* 580 (TEX). QUICHÉ: 1942, *Aguilar* 1942 (F). **Mexico.** AGUASCALIENTES: below Presa Calles, 31 Aug 1939, *Shreve* 9278 (ARIZ, GH). CHIHUAHUA: Arroyo Hondo, Sierra Charuco, 11 Sep 1935, *Gentry* 1752 (ARIZ, F, GH, NY, UC, US); Municipio de Guadalupe & Calvo, Nabogame, 11 Oct 1959, *Gentry, Correll & Arguelles* 17970 (US). COLIMA: Colima, 9 Jan-6 Feb 1891, *Palmer* 1163 (GH, NY, US); Alzada, 25 Aug 1966, *Stuessy* 729 (TEX). DISTRITO FEDERAL: Mixcoac, Olivar, 7 Sep 1913, *Arsène* s.n. (US); San Andrés, Aug 1930, *Lyonnet* 569 (US); Pyramid of Cuicuilco, Tlalpán, 15 Aug 1935, *MacDaniels* 41 (F); near Tlalpán, 1 Sep 1936, *MacDaniels* 723 (F); San Ángel, 12 Aug 1910, *Orcutt* 3548 (F). DURANGO: vicinity of Durango, Jun 1896, *Palmer* 286 (F, GH, NY, UC, US); ca 30 mi N of Durango, 12 Nov 1959, *Gentry & Arguelles* 18152 (US). GUANAJUATO: Guanajuato, *Dugès* 461 (GH), 462 (GH); Obregón, 13 Oct 1895, *Volkens* 1134 (GH, NY). GUERRERO: Taxco, 28 Sep 1937, *Abbott* 445 (GH), 5 Sep 1959, *Degener* 26220 (NY); Mina, Zihuaqueo-Filo Mayor, 20 Aug 1936, *Hinton et al.* 9293 (GH, US). JALISCO: La Barranca, 24 Nov 1930, *Jones* 27773 (DS [2], F, NY, POM, UC); NE slopes of Nevado de Colima, below Canoa de Leoncito, 17 Oct 1952, *McVaugh* 13576 (SMU, US); near Santa Mónia, 12-13 Nov 1952, *McVaugh* 14107 (SMU, US); near Guadalajara, 29 Oct 1888, *Pringle* 1767 (F, GH, NY [2], UC, US); 2 mi NW of La Barca, 23 Aug 1966, *Stuessy* 705 (TEX). MEXICO: Valley of México, Tizapán, 12 Feb 1865-66, *Bourgeau* 841 (GH); Temascaltepec, Temascaltepec, 2 Sep 1932, *Hinton* 1521 (NY); Temascaltepec, Chorrera, 25 Sep 1932, *Hinton* 1838 (GH, NY, US); Temascaltepec, Ixtapán, 2 Nov 1932, *Hinton* 2480 (NY, UC, US); ½ mi N of Tepetlixpa, 16 Aug 1966, *Stuessy* 668 (TEX). MICHOACÁN: 13 mi S of Uruapán, 28 Oct 1962, *Cronquist* 9745 (NY, SMU, TEX, US); ca 11 mi W of the Michoacán-Mexico state border on rte 15, 3 Aug 1960, *King* 3600 (DS, NY, SMU, TEX, UC, US); E of San Juan Nuevo (ca 8 km S of Uruapán), 11-15 Oct 1961, *King & Soderstrom* 4707 (NY, SMU, TEX, UC, US); 2 mi W of Ciudad Hidalgo, 21 Aug 1961, *Powell & Edmondson*

816 (DS, F, TEX); 0.8 mi NW of Zitacuaro, 1 Sep 1965, *Stuessy* 379 (TEX). MORELOS: vicinity of Cuernavaca, 28 Jan 1932, *Asplund* 517 (NY), 31 Aug 1910, *Orcutt* 3892 (F, US). NAYARIT: vicinity of Jalisco, 10 Nov 1925, *Ferris* 5890 (DS, GH, US); Tepic, 14 Feb 1927, *Jones* 23398 (POM), 10 Feb 1927, *Jones* 23402 (POM). PUEBLA: vicinity of Puebla, Manzanilla, Nov 1908, *Arsène* 3523 (US); ca 5 mi W of Puebla, 29 Jul 1960, *King* 3560 (NY, TEX, UC, US); vicinity of Puebla, Hacienda Batan, 20 Dec 1911, *Nicolas* 6150 (GH, US); Teteles, 9 Jul 1966, *Stuessy* 497 (TEX); 3 mi W of Puebla, 14 Jul 1966, *Stuessy* 503 (TEX). OAXACA: Cerro San Felipe, 20 Sep 1908, *Conzatti* 2291 (F); vicinity of Totontepec, 15-20 Jul 1894, *Nelson* 715 (US); Sierra de San Felipe, Oct 1894, *Smith* 351 (F); N city limits of Zimatlán, 14 Aug 1966, *Stuessy* 654 (TEX). SAN LUIS POTOSÍ: 32 mi E of San Luis Potosí, 19 Sep 1960, *Crutchfield & Johnston* 5643a (TEX); near San Luis Potosí, Aug 1876, *Schaffner* 270 in part (GH, NY). SINALOA: Ocurahui, Sierra Surotato, 1-10 Sep 1941, *Gentry* 6350 (ARIZ, DS, GH, NY). VERACRUZ: Zacualpán, Dec 1907, *Purpus* 2849 (F, GH, NY, UC, US); Mt Orizaba, 22 Aug 1891, *Seaton* 54 (F, GH, NY, US); 8 mi NW of Jalapa, 9 Jul 1966, *Stuessy* 494 (TEX); 34 mi NW of Tehuacán, 14 Jul 1966, *Stuessy* 505 (TEX); ½ mi W of San Juan, near Pico de Orizaba, 15 Jul 1966, *Stuessy* 511 (TEX). UNITED STATES. **California:** LOS ANGELES CO.: Cienega, Aug 1902, *Braunton* 625 (DS, UC [2], US); Los Angeles, Aug 1902 [03?], *Grant* 763 (ARIZ, F, UC), Sep 1879, *James* s.n. (NY, US); between Los Angeles & Compton, Nov 1895, *McClatchie* s.n. (DS, NY, POM); Los Angeles, Oct 1882, *S. & W. Parish* 1171 (DS, F, GH, NY, US [2]).

36. **Melampodium glabrum** S. Wats. Proc. Amer. Acad. Arts & Sci. **26**:139. 1891. TYPE: MEXICO: Guanajuato, valley near Irapuato, 20 Sep 1889, *C. G. Pringle* 2821 (Holotype, GH!).

Annual herbs, 25-60 cm tall. Stems erect, 1-10 mm diam, somewhat soft and watery when fresh, glabrous near base and covered with bladdery hairs toward apex. Peduncles 2.5-5.5 cm long. Leaves sessile, oblong-oblanceolate, 2.5-6 cm long, 0.7-2.1 cm wide, at apex obtuse, at base subauriculate, with both surfaces waxy and glabrous; margin sinuate-dentate. Heads 4.3-5 mm tall, 7-11 mm wide. Outer involucre spreading, 8-10(14) mm diam; bracts 5, fleshy, slightly connate at base, imbricate, ovate-orbiculate, 4.2-6 mm long, 3.8-4.5 mm wide, at apex obtuse with abaxial surface glabrous; margin herbaceous. Fruits 2.5-2.9 mm long,

with lateral surfaces smooth to moderately striate or nervose. Ray florets 6-8; ligules yellow, oblong-ovate, 1.3-3.4 mm long, 0.7-1.4 mm wide. Disc florets 30-50; corollas yellow, 1 mm diam, with throat 0.9 mm and tube 0.8 mm long. Paleae oblanceolate-elliptic, 1.6 mm long, 0.5 mm wide; apex yellow, with margin entire; midrib prominent, glabrous. Chromosome number, $n = 11$.

Very moist areas in pine-oak forests or high altitude grasslands in the Mexican states of Guanajuato, Jalisco, and Michoacán (Fig. 13), ca 1890 m. Flowering dates, Aug-Sep.

This species is an attractive, fleshy, little herb found often in moist depressions on roadsides. The large foliaceous outer involucral bracts and conspicuous blackish fruits as well as the $n = 11$ chromosome number indicate that *M. glabrum* is allied closely to *M. perfoliatum*.

REPRESENTATIVE SPECIMENS. **Mexico.** GUANAJUATO: near San Miguel Allende, Aug 1947, *Kenoyer* 2421 (GH). JALISCO: valley of the Lerma near La Barca, 16 Sep 1891, *Pringle* 3863 (DS, G, GH [2], MA, MSC, NY [2], P, UC [2], US, W); 3 mi N of La Barca, 24 Aug 1966, *Stuessy* 708, 709 (TEX). MICHOACÁN: vicinity of Morelia, 13 Sep 1910, *Arsène* s.n. (US); 9 mi S of jct rte 15 on rd to Cotija, 24 Aug 1966, *Stuessy* 714 (TEX).

37. **Melampodium nutans** Stuessy, Brittonia 22:122. *f. 9.* 1970. TYPE: MEXICO: Colima, 12 mi S of Colima on rte 110, 25 Aug 1966, *T. F. Stuessy* 721 (Holotype, US!; isotypes, DS! F! GH! MICH! NY! TEX! UC!).

Annual herbs, 16-40 cm tall. Stems erect, 1.2-2 mm diam, hispidulous-strigillose with hairs 0.2-0.5 mm long. Peduncles 5.5-6.5 cm long. Leaves ovate to rhombic, with tapering petioles 1-3 cm long, blades 4-5 cm long, 2-4 cm wide, at apex acuminate, at base attenuate, with both surfaces strigose with hairs 0.5 mm long; margin subentire to serrate. Heads 4-6 mm tall, 7-8(10) mm diam. Outer involucre spreading, 8-14 mm diam; bracts 3 (rarely 4), slightly connate at base, separate, ovate to narrowly ovate, 4-7 mm long, 2.5-4 mm wide, at apex acute, with abaxial

surface strigose with hairs 0.3-0.5 mm long; margin herbaceous. Fruits 1.8-2.1 mm long, with lateral surfaces ribbed and reticulated; hood at apex muticous to cirrhous[16], with tapering appendage up to 6 mm long. Ray florets 5-7; ligules yellow-orange, orbiculate, margins imbricate, 2-3 mm long, 2-4 mm wide. Disc florets 40-80; corollas yellow-orange, 1.7 mm diam, with throat 0.7 mm and tube 1 mm long. Paleae narrowly obovate, 2 mm long, 1 mm wide; apex yellow, with margin laciniate; midrib distinct, puberulent with hairs 0.1 mm long. Chromosome number, $n = 11$.

Tropical deciduous forests of Colima, Jalisco, Michoacán and Oaxaca, Mexico (Fig. 13), 50-500 m. Flowering dates, Aug-Nov.

The hoods on fruits of *M. nutans* are shorter and thicker than are the hoods of species of section *Melampodium.* Such a difference is not unexpected, however, because *M. nutans* differs in many other respects from the taxa in that section. Due to the spreading outer involucral bracts, rudimentary disc ovaries, herbaceous habit, and chromosome number of $n = 11$ of this species, it clearly belongs in section *Alcina* near *M. perfoliatum* and *M. glabrum.*

REPRESENTATIVE SPECIMENS. **Mexico.** COLIMA: ca 11 mi SSW of Cd Colima, 21 Sep 1958, *McVaugh* 18070 (MICH), 25 Nov 1959, *McVaugh & Koelz* 1054 (MICH); 12 mi S of Cd Colima, 25 Aug 1966, *Stuessy* 720 (TEX). JALISCO: between Sierra de los Corales & Tepalcatepec, Michoacán, 26 Oct 1963, *Feddema* 2238 (MICH); Tecalitlán, 26 Oct 1963, *Rzedowski* 17514 (MICH, OS). MICHOACÁN: ca 5 km NW of Áquila, 23 Nov 1963, *Feddema* 2700 (MICH); 15 mi SSW of Apatzingán, 2 Aug 1940, *Leavenworth* 431 (F, GH, NY), 432 (F); 8 km NW of Áquila, 23 Nov 1963, *Rzedowski* 17921 (MICH, OS). OAXACA: 3 km SW of Puerto Ángel, 24 Sep 1965, *Rzedowski* 21155 (OS).

[16]Isotype material in my preserved personal collection has fruits with both muticous hoods and hoods with long cirrhous appendages in the same head (cf. Fig. 9E in Stuessy, 1970b).

DOUBTFUL SPECIES

Melampodium angulatum Sessé & Moc. Pl. Nov. Hispan. 149. 1890. TYPE: MEXICO: Guerrero, Ayahualtempa, Aug 1789, *M. Sessé et al.* s.n. (Holotype, MA?). From the description and locality data this taxon seems most similar to *M. perfoliatum*, although the leaf undersurface in the latter species is never "tomentose."

Melampodium dichothomum Sessé & Moc. Pl. Nov. Hispan. 149. 1890. TYPE: MEXICO: Guerrero, Mazatlán [ca 15 km S of Chilpancingo; Sprague (1926), and Rickett (1947)], Jun 1789, *M. Sessé et al.* "3977." MA has a mixed sheet with both *M. montanum* and *M. divaricatum* and another sheet with *M. divaricatum*. A sheet at F has a fragment of only *M. divaricatum*. The description more closely resembles *M. montanum*, but both *M. divaricatum* and *M. montanum* are found in Guerrero, and neither seems explicitly excluded by the description.

Melampodium diversifolium Sessé & Moc. Fl. Mex. ed. 2. 197. 1894. TYPE: locality unknown, 1787-1804, *M. Sessé et al.* s.n. (Holotype, MA?). The description seems to refer to *M. linearilobum* or *M. longipes*, but not mentioned are several diagnostic characters such as the leaf undersurface and margins of the outer involucral bracts.

Melampodium pinnatum Sessé & Moc. Pl. Nov. Hispan. 149. 1890. TYPE: MEXICO: Michoacán, Apatzingán, Oct 1790-91, *M. Sessé, J. M. Mociño & J. Castillo* s.n. (Holotype, MA?). The description is too general to allow any specific placement.

Melampodium rhombifolium Sessé & Moc. Pl. Nov. Hispan. 149. 1890. TYPE: MEXICO: México, San Augustín, Sep 1787-1804, *M. Sessé et al.* s.n. (Holotype, MA?). The character "Receptaculum nudum," if correct, would exclude this taxon from *Melampodium*.

Melampodium rhombifolium Sessé & Moc. Fl. Mexic. ed. 2. 195 [second on page]. 1894. *nom. illegit. non* Sessé & Moc. 1890. *nec* Sessé & Moc. [first on page]. 1894. TYPE:

MEXICO: "Hortis Sancti Augustini, prope Mexicum," Aug-Sep 1787-1804, *M. Sessé et al.* s.n. (Holotype, MA?). Specific affinity cannot be determined from the description.

EXCLUDED NAMES

Melampodium L. sect. *Acanthospermum* (Schrank) Baillon, Hist. Plant. 8:231. 1882. =*Acanthospermum* Schrank, Pl. Rar. Hort. Acad. Monac. 53. 1820.

Melampodium achillaeoides (Less.) Hemsley, Biol. Centr. Am. Bot. 2:145. 1881. =*Villanova achillaeoides* (Less.) Less. Syn. Gen. Comp. 256. 1832. TYPE: MEXICO: "los Llanos de Perote," Sep 1828, *C. J. W. Schiede* 354 (Holotype, HAL!; photograph of holotype, OS! TEX!).

Melampodium anomalum M. E. Jones, Contr. West. Bot. 18:72. 1933. TYPE: MEXICO: Jalisco, near Guadalajara, La Barranca, 17 Nov 1930, *M. E. Jones* 27727 (Lectotype, POM; isotype, MO! NY!; photograph and fragment of lectotype, US!). =*Tragoceras schiedeanum* Less. Linnaea 9:269. 1834. *fide* Blake (1945) and Torres (1963).

Melampodium australe Loefl. Iter Hisp. 268. 1758. TYPE: VENEZUELA: vicinity of Barcelona, 15 Feb 1755, *P. Loefling* "151" (Holotype, LINN). =*Acanthospermum australe* (Loefl.) Kuntze, Rev. Gen. Pl. 1:303. *t. 23, h-m.* 1891.

Melampodium baranguillae Spreng. Syst. 3:619. 1826. TYPE: COLOMBIA: "Ad fl. Magdalenae," date unknown, *C. G. Bertero* s.n. (Holotype, P-CO). Blake (1930) saw the type of *M. baranguillae* in the Schultz-Bipontinus Herbarium and found "it to be identical with *Sclerocarpus columbianus* Rusby & Blake."

Melampodium bonairense Boldingh, Fl. Neder. West-Ind. Eil. 393. 1913. Fl. Dutch West Ind. Is. 2:107. *t. 9.* 1914. TYPE: DUTCH WEST INDIAN ISLANDS: Island Curaçao, Malpais, 28-30 Oct 1909, *I. Boldingh* M.14 (Holotype, U; paratype [*Boldingh* 7401], P!; fragment of P paratype, US!; photograph of K paratype [*Boldingh* 7401], US!). =*Baltimora* sp.

Melampodium camphoratum (L.f.) Baker in Martius, Fl. Bras. 6(3):161. 1884. =*Unxia camphorata* L.f. Suppl. 368. 1781. TYPE: SURINAM: "locis arenosis," date unknown, *C. G. Dalberg* s.n. (HOLOTYPE, LINN; photograph of holotype, OS!).

Melampodium digynum (Steetz in Seem.) Jackson, Index Kew. 2:188. 1895. *Unxia digyna* Steetz in Seem. Bot. Voy. Herald. *t. 30.* 1853. text 154. 1854. TYPE: PANAMA: "about Panama [City]," Nov 1846, *B. C. Seemann* 46 (HOLOTYPE, BM; photograph and fragment of K isotype, US!; photograph of K isotype, F! US [2]!). =*Unxia camphorata* L.f. Suppl. 368. 1781.

Melampodium? dombeyanum DC. Prodr. 5:520. 1836. TYPE: PERU: locality and date unknown, *J. Dombey* s.n. (Holotype, G-DC; isotype, P!; photograph of holotype, IDC 800. 923: III. 6!; photograph of P isotype, OS! TEX!). S. F. Blake (1930) saw the type in the Prodromus Herbarium and notes that it "has shown its identity with *Sigesbeckia flosculosa*" L'Her. Stirp. Nov. 37. *t. 19.* 1785-86.

Melampodium durandi (A. Gray) M. E. Jones, Contrib. West. Bot. 15:156. 1929. *Hemizonia durandi* A. Gray, Proc. Amer. Acad. Arts & Sci. 6:549. 1865. TYPE: CALIFORNIA: Nevada Co., ". . . in the vicinity of Nevada [City]" [Durand, 1855], ca. 3000 ft., 1851, *H. Pratten* s.n. (Holotype, PH?). =*Madia minima* (A. Gray) Keck, Madroño 10:22. 1949.

Melampodium geminatum Brandg. Zoe 5:223. 1905. TYPE: MEXICO: Sinaloa, Cofradia [ca 30 mi E of Culiacán near Durango border], 24 Oct 1904, *T. S. Brandegee* s.n. (Lectotype chosen, UC!). = *Baltimora* sp.

Melampodium? hidalgoa DC. Prodr. 5:521. 1836. *nom. superfl.* of *Melampodium ternatum* (Llave & Lex.) DC. =*Hidalgoa ternata* Llave & Lex. Nov. Veg. Descr. 1:15. 1824.

Melampodium hirsutum (Rich.) Jackson, Index Kew. 2: 188. 1895. *Unxia hirsuta* Rich. Act. Soc. Hist. Nat. Par. 1:105. 1792. TYPE: FRENCH GUIANA: locality unknown, 1792, *J. B. Leblond* 346 (Holotype, P; isotype, G!; photograph of G isotype, OS! TEX!). =*Unxia camphorata* L.f. Suppl. 368. 1781.

Melampodium humile Sw. Prodr. Veg. Ind. Occ. 114. 1788. TYPE: JAMAICA: "Domingo," 1783-1787, *O. Swartz* s.n. (Holotype, S; photograph of B isotype, TEX!). =*Acanthospermum humile* (Sw.) DC. Prodr. 5:222. 1836.

Melampodium L. sect. *Lecocarpus* (Dcne.) Baillon, Hist. Plant. 8:231. 1882. =*Lecocarpus* Dcne. Bot. Voy. Venus, *t. 14.* 1846.

Melampodium minimum (A. Gray) M. E. Jones, Contrib. West. Bot. 15:156. 1929. *Hemizonia minima* A. Gray, Proc. Amer. Acad. Arts & Sci. **6**:549. 1865. TYPE: IDAHO: "Dry soil, near Soda Springs," 8600 ft., 1860-1862, *W. H. Brewer* s.n. (Holotype, GH?). =*Madia minima* (A. Gray) Keck, Madroño **10**:22. 1949.

Melampodium minutiflorum M. E. Jones, Contrib. West. Bot. 18:72. 1933. TYPE: MEXICO: Guadalajara, La Barranca, 17 Nov 1930, *M. E. Jones* 27738 (Lectotype, POM; isotype, MO! US!; photograph and fragment of lectotype, US!). =*Galeana pratensis* (H.B.K.) Rydberg, Fl. N. Amer. 34(1):42. 1914.

Melampodium paludicola Taub. Engl. Bot. Jahrb. 21:455. 1896. TYPE: BRAZIL: Goias, "in paludibus ad flumen Paranahyba [Paranaiba]," Feb 1893, *E. Ule* 2978 [=397] (Holotype, P!; isotype, F!; fragment of holotype, US!; photograph of holotype, F! OS! TEX! US!). Definitely not a *Melampodium;* "the description of which suggests a *Sclerocarpus*" (Robinson, 1901).

Melampodium? ruderale Sw. Fl. Ind. Occ. 3:1372. 1806. TYPE: JAMAICA: "in ruderatis Jamaicae australioris," date

unknown, *O. Swartz* s.n. (Holotype, S?). =*Eleutheranthera ruderalis* (Sw.) Sch. Bip. Bot. Zeit. 24:239. 1866.

Melampodium suffruticosum Baker in Martius, Fl. Bras. 6(3):162. 1884. TYPE: VENEZUELA: "prope Esmeralda in ditione fluminis Orinoco," Dec 1853, *R. Spruce* 3225 (Holotype, K!; isotypes, G! NY! P!; photograph of holotype, OS! TEX! US!). =*Unxia suffruticosa* (Baker) Stuessy, Brittonia 21:319. 1970.

Melampodium? ternatum (Llave & Lex.) DC. Prodr. 5: 521. 1836. =*Hidalgoa ternata* Llave & Lex. Nov. Veg. Descr. 1:15. 1824. TYPE: MEXICO: Veracruz, ". . . in margine densissimarum silvarum, prope ultimam cataractam fluminis Blanco, non longe à S. Jose del Corral [near Orizaba]," Apr [year?], *P. La Llave* s.n. (Holotype, MA?).

Melampodium L. subg. *Unxia* (L.f.) Baker in Martius, Fl. Bras. 6(3):162. 1884. =*Unxia* L.f. Suppl. 56. 1781.

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LIST OF TAXA OF MELAMPODIUM

1. *M. americanum* L.
2. *M. diffusum* Cass.
3. *M. pilosum* Stuessy
4. *M. longipes* (A. Gray) Robins.
5. *M. linearilobum* DC.
6. *M. leucanthum* Torr. & A. Gray
7. *M. cinereum* DC.
   - 7a. *M. cinereum* DC. var. *cinereum*
   - 7b. *M. cinereum* DC. var. *hirtellum* Stuessy
   - 7c. *M. cinereum* DC. var. *ramosissimum* (DC.) A. Gray
8. *M. argophyllum* (A. Gray ex Robins.) Blake
9. *M. sericeum* Lag.
10. *M. pringlei* Robins.
11. *M. strigosum* Stuessy
12. *M. longicorne* A. Gray
13. *M. nayaritense* Stuessy
14. *M. cupulatum* A. Gray
15. *M. appendiculatum* Robins.
16. *M. sinuatum* Brandg.
17. *M. rosei* Robins.
18. *M. tenellum* Hook. & Arn.
19. *M. glabribracteatum* Stuessy
20. *M. longipilum* Robins.
21. *M. longifolium* Cerv. ex Cav.
22. *M. mimulifolium* Robins.
23. *M. gracile* Less.
24. *M. microcephalum* Less.
25. *M. paniculatum* Gardn.
26. *M. divaricatum* (Rich. in Pers.) DC.
27. *M. costaricense* Stuessy
28. *M. dicoelocarpum* Robins.

29. *M. tepicense* Robins.
30. *M. sinaloense* Stuessy
31. *M. bibracteatum* S. Wats.
32. *M. repens* Sessé & Moc.
33. *M. montanum* Benth.
    33a. *M. montanum* Benth. var. *montanum*
    33b. *M. montanum* Benth. var. *viridulum* Stuessy
34. *M. aureum* Brandg.
35. *M. perfoliatum* (Cav.) H.B.K.
36. *M. glabrum* S. Wats.
37. *M. nutans* Stuessy
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E. Excluded taxon

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Paynet, A. M. & H. D. Hulan 1213 (23).
Peebles, R. H. & G. J. Harrison 4680 (12).
Peebles, R. H., G. J. Harrison & T. H. Kearney 4614 (11).
Pennell, F. W. 1335 (27); s.n. (18).
Pereira, E. & G. Pabst 8505 [34972] (26).
Pipes, D. 81 (23).
Pittier, H. 57, 60, 429, 6963 (25).
Pohl, J. E. 1368 [1276] (25).
Porter, C. L. 4262 (6).
Powell, A. M. & J. Edmondson 551 (21); 579 (9); 646 (23); 660 (9); 756 (26); 758 (2); 816 (35); 908 (17).
Pratten, H. s.n. (E).
Pringle, C. G. 10 (11); 55 (12); 297, 754 (11); 1019 (6); 1045 (11); 1767 (35); 2819 (26); 2821 (36); 3230 (31); 3639 (20); 3818 (33b); 3863 (36); 3923 (26); 4322 (24); 4537 (20); 4598 (4); 4666 (33a); 5257 (32); 5309 (9); 5722 (10); 6455 (21); 6491 (11); 6728 (9); 7321 (24); 7327 (32); 8466 (23); 8609 in part (9), (11); 8610 (32); 9008 (7b); 9162 (5); 9177 (23); 9301 (31); 9325 (21); 9331 (11); 9361 (33b); 9937 (23); 10065 (5); 11548 (11); 13068 (31); 13069 (24).
Purpus, C. A. 416 (16); 1003, 1003a (8); 1809 (32); 2813, 2813′ (21); 2849 (35); 3822, 3822a (34); 4730 (8); 5619 (20); s.n. (8).

Ramírez, J. 44 (7a).
Reese, J. A. 94 (12).
Reko, B. P. 3812 (5).

Reséndez, O. I. 52 (7b).
Richard, L. C. M. s.n. (26).
Ricksecker, A. E. "S" (26).
Riddell, J. L. s.n. (6).
Ríos, A. & H. Cavazos 231, 264 (7a).
Ripley, H. D. & R. C. Barneby 13708 (24).
Robinson, C. B., Jr. 11835 (2).
Rock, H. F. L. M-442 (9).
Rodríguez, J. J. 72 (7b).
Rodríguez, J. V. 1662 (25); 3341 (26); 3735 (25).
Rojas 86 (9).
Rose, J. N. 1568 (17); 3183 (4); 3271 (17); 3476 (13); 3617 (9); s.n. (17).
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Rose, J. N. & R. Hay 6244 (32); 6275 (9).
Rose, J. N., J. H. Painter & J. S. Rose 9308 (23); 10137 (20).
Rose, J. N., P. C. Standley & P. G. Russell 14307 (1).
Rowlee, W. W. & H. E. 179 (5).
Russell, N. H. 11511 (6).
Russell, P. G. & M. J. Souviron 2 (15).
Rzedowski, J. 9320 (33a); 17514, 17921, 21155 (37); 20748 (1); 21322 (33b); 26618 (18).

Safford, W. E. 1264 (8).
Sánchez, A. 105 (7a).
Schaffner, J. G. 270 in part (9), (35); 271 (9); s.n. (14), (32).
Schiede, C. J. W. 217 (24); 354 (E).
Schiede, C. J. W. & F. Deppe 1254 (23).
Schott, A. 72, s.n. (15).
Schroeder, A. H. 120 (8).
Seaton, H. E. 54 (35); 461 (24).
Seemann, B. C. 46 (E).
Sessé, M. "3977" (D); "3978" (24); "3981" (32); "3983", s.n. (26); s.n. (D).
Sessé, M. & J. M. Mociño s.n. (9).
Shank, P. J. & A. Molina R. 4236 (27).
Sharp, A. J. 44116 (32); 44208 (21); 44961 (9).
Shinners, L. H. 7183 (6); 7395 (7a); 12190 (6); 17659, 17708 (7a); 26390, 31236, 31559 (6).
Shreve, F. 4965, 6003 (12); 6758 (15); 7685, 7709 (12); 7821 (17); 7918 (6); 9278 (35).
Sinclair, A. s.n. (26).
Skutch, A. F. 1036 (33b); 1550 (25); 1592 (9); 1709 (25); 2041 (26); 3968 (27).
Small, J. K. & E. T. Wherry 12134 (6).
Smith, A. 2922 (27).
Smith, C. L. 351 (35); 1605 (23); 1655 (24).
Smith, H. H. 514 in part (26).
Smith, J. D. 2334 (25); 2382 (26).
Solís, F. 52 (25); 56 (27).
Solís, M. J. 124 (7a).
Spruce, R. 3225 (E).
Standley, P. C. 11226 (26); 12105, 15756, 17710 (25); 19722 (26); 20260 (25); 21648, 21789 (26); 22687, 22718, 22864, 25149 (25); 26708, 27175 (5); 28678 (25); 32757 (27); 36058, 38971 (25); 39021, 41531 (27); 56290, 56522 (25); 59769 (9); 60326, 60413 (25); 60493 (5); 63265, 64303, 64595, 68866 (25); 73774, 74071, 74125, 74813, 75620 (5); 76429, 77073 (25); 77149 (26); 77440,

78268, 79869 (25); 82849 (9); 87933 (25).
Standley, P. C. & J. Chacón P. 6625, 6660 (25).
Standley, P. C. & E. Padilla V. 2755, 3630 (25).
Standley, P. C. & J. Valerio 48814 (27).
Stanfield, Mrs. V. E. s.n. (6).
Stanford, L. R., K. L. Retherford & R. D. Northcraft 186 (8); 1077 (1); 1078 (23).
Stanford, L. R., L. A. Taylor & S. M. Lauber 2313 (26).
Steere, W. C. 1805 (23).
Stevens, F. L. 136 (25).
Stevens, G. W. 325 (6).
Stewart, R. M. 84 (6).
Steyermark, J. A. 29041, 30309 (5); 31670 (26); 32847 (25); 43745 (26); 48234 (33b); 50392 (9); 50490 (33b); 50530 (9); 50539 (23); 50724 (5); 50773 (25); 50916 (20); 51452 (23).
Stork, H. E. 2486 (27).
Stork, H. E. & J. L. Morrison 8920 (26).
Stuessy, T. F. 147, 167, 180, 230 (6); 274 (23); 282, 318 (26); 328 (20); 342 (26); 344 (20); 345 (26); 346, 347 (20); 348, 351 (26); 356 (23); 359 (26); 361 (5); 364 (9); 365 (26); 366, 369 (2); 374 (20); 377 (9); 379 (35); 383 (24); 393 (23); 397 (4); 401 (18); 403 (26); 404 (17); 414 (6); 425, 429 (7a); 450 (7c); 463, 466 (23); 471 (1); 473 (26); 494, 497, 503, 505, 511 (35); 526, 527, 528 (26); 531 (23); 532 (26); 533 (23); 534, 535 (26); 537 (23); 543 (26); 544 (23); 545 (26); 546 (23); 547, 548, 550 (26); 559 (33b); 562 (23); 566, 567, 568, 570 (33b); 571 (1); 574 (23); 578 (25); 580 (35); 582, 585 (25); 586 (26); 587 (25); 588 (26); 589 (25); 592 (26); 594 (25); 602 (1); 603 (35); 605 (26); 607 (5); 608, 609, 611 (26); 613 (5); 614, 615, 616 (26); 619 (5); 620, 621, 623, 624, 625 (26); 627 (24); 632 (1); 634, 636, 637 (20); 638 (24); 639 (20); 640 (24); 642 (9); 645 (26); 647 (9); 650 (5); 654 (35); 659 (21); 660 (9); 663 (34); 667 (20); 668 (35); 670 (32); 675, 676 (31); 677 (26); 682, 684 (34); 688 (1); 690 (9); 693 (28); 694 (23); 695 (3); 697, 698 (5); 702 (26); 703 (9); 705 (35); 708, 709 (36); 713 (23); 714 (36); 715 (28); 720, 721 (37); 722 (23); 723 (26); 724 (1); 725 (26); 727 (1); 728 (26); 729 (35); 730 (9); 738 (4); 740 (9); 743 (26); 745 (18); 746 (26); 748, 750 (17); 751, 752 (6); 771 (7a); 778, 787 (7c); 826 (23); 829 (26); 854 (7a); 855, 856 (7b); 857, 868 (7a); 902, 912 (7b); 1016, 1038, 1054 (11); 1122, 1127 (6); 1128 (11).
Stuessy, T. F. & W. Renold 1261 (7c); 1284 (7a).
Sullivan, W. & B. L. Turner 34 (6).
Swartz, O. s.n. (E).

Taylor, M. 115 (21).
Tetters, S. 18 (6).
Tharp, B. C. & M. C. Johnston 541 [802A], 541922 (7a).
Tharp, B. C. & Miller 51-312 (6).

Thompson, B. & B. Fields 332 (2).
Thompson, B. & A. Graham 18 (6).
Thompson, E. s.n. (1).
Thornber, J. J. 7404, 8121, 9050 (12).
Thurber, G. 937 (12).
Tonduz, A. 10144 (25); 13615 (26).
Tonduz, A. & Rojas 203 (25).
Torres R., R. 50 (25).
Townsend, C. H. T. & C. M. Barber 351 (11); 376 (15).
Tracy, S. M. & F. S. Earle 23 (6).
Triana, J. J. 1331 (25).
Tucker. J. M. 455 (5); 585 (26); 1313 (25); 2565 (9).
Tuerckheim, H. von 114 (25); 124 (26); 761 (25); 3955 (9); 8417 (25).
Turner, B. L. 4490 (7a); 4620 (11); 4790 (6); 5006 (7a); 5632, 5673, 5735 (6).
Turner, B. L. & T. E. Melchert 4840 (6).
Turner, B. L. & A. M. Powell 1116 (11).
Turner, C. 7 (6).
Turner, R. M., R. A. Dodge & C. T. Mason, Jr. 2068 (12).
Turner, R. M. & C. H. Lowe, Jr. 2074 (15).

Ule, E. 2978 [397] (E).

Velasco, L. V. 8946 (25).
Volkem 2564, 2774 (25); 2973 (1); 3013 (26).
Volkens, G. L. A. 1134 (35).

Walker, M. L. 93 (7c).
Wallis, C. 4807 (6).
Warnock, B. H. 9229, 13507 (11); 46217 (6).
Warscewicz, J. von s.n. (26).
Waterfall, U. T. 3781, 4818 (6); 15805 (7b); 16198 (31); 16342 (9).
Waterfall, U. T. & C. S. Wallis 13702 (31); 13886 (9); 13960 (11); 14288 (23).
Webster, M. B. 140 (33b).
White, O. E. 100 (26).
White, S. S. 2642 in part (9), (11); 2784 (15); 2788 (11); 3516, 3908, 4153 (15); 4587 (6).
Whitehouse, E. 9841 (6).
Wiegand, M. C. & G. B. Upton 4439 (6).
Wiggins, I. L. 7021, 7388, 7444, 7533 (15); 11507 (14); 11765 (6); 14377 (16).
Wiggins, I. L. & R. C. Rollins 281 (14); 433 (15).
Wilbur, R. L. & C. R. 1395 (1); 2416 (29).
Wilcox, T. E. 335, s.n. (12).
Williams, L. O. 5643, 18257 (25).
Williams, L. O. & A. Molina R. 13398 (26).
Wilson, P. 9553 (35).
Winbery, J. E. & C. M. Rowell, Jr. 2492 (2).
Woodson, R. E., Jr., P. H. Allen & R. J. Seibert 1370 (26).
Wooton, E. O. 117 (6); s.n. (7c).
Worth, C. R. & J. L. Morrison 8807 (17).
Wright, C. 311 (6); 1205 (12).
Wright, J. T. 42-54 (6).
Wright, W. G. 1213 (17).
Wynd, F. L. & C. H. Muller 132 (8); 214 (7b).

Xantus, L. J. s.n. (1).

York, C. L. & G. 54037 (6).
Young, M. S. s.n. (11).
Yuncker, T. G., R. F. Dawson & H. R. Youse 5519 (25).

Zamora, F., J. B. Paxon & F. A. Barkley 16M905 (11).

SPORES, CHROMOSOMES AND RELATIONS OF THE FERN PELLAEA ATROPURPUREA

ALICE F. TRYON

The Purple Cliff-Brake, *Pellaea atropurpurea,* is the only American species of the large complex of cheilanthoid ferns that has a range extending from the tropics into northern regions, including New England. Only triploid plants are known, which evidently are hybrids, and they are apogamous with 87 chromosomes in the sporophyte and spore mother cells. The species is a tool of some biological interest as there appears to be no evidence of sexual reproduction, although the specimens are highly variable throughout the geographic range. Northern Mexico and the adjacent southwestern United States is regarded as a center of dispersal of *Pellaea* section *Pellaea* in America, for eleven of the fourteen species have distributions that converge there or have close relatives that do. Studies of the cytology and spores of *P. atropurpurea* and two other species, *P. notabilis* and *P. ternifolia,* that occur in this central area, provide new data for establishing relationships among these species, and insights on the possible origin of *P. atropurpurea.*

MATERIAL AND METHODS

The general geographic distributions of the taxa are outlined on the maps; localities more than 600 miles from the main range are indicated by separate dots. Ranges are based on data from my revision of *Pellaea* section *Pellaea* (A. Tryon, 1957) and from recent reports of range extensions. The wide cytological sampling of populations is shown on the maps. The new cytological records are combined with earlier ones in Table 1. Meiosis was studied in sporangia fixed in 3:1 absolute ethyl alcohol: glacial acetic acid. Mitosis was examined in root tips fixed in the same solution following pretreatment for three hours with saturated aqueous solution of paradichlorobenzine.

Scanning electron microscope photographs were obtained from spores undercoated with carbon prior to coating with an alloy of palladium-gold while rotating and tilting the

TABLE 1. CHROMOSOME NUMBERS OF PELLAEA (*previous report, see text).

Species	Number	Ploidy	Collector	Locality
Pellaea atropurpurea	87-meiotic	3×	*Tryon & Tryon* 5523 (MO)	USA: Mo., Gray Summit *
	87-meiotic	3×	*T. Taylor*, in 1951 (UBC)	Canada: B. C., Fairmount Hotsprings *
	87-meiotic	3×	*Monette*, in 1950 (DOA)	Canada: Que., Campbell's Bay *
(Figs. 9, 16)	87-meiotic	3×	*Rollins & Tryon* 5860 (GH)	Mexico: N. L., Chipinque Mesa
(Fig. 11)	87-meiotic	3×	*Rollins & Tryon* 5860 (GH)	Mexico: N. L., Chipinque Mesa
Pellaea notabilis	29	2×	*Knobloch* 1963 (GH)	Mexico: N. L., C. San Francisco
(Figs. 12, 15)	29	2×	*Marroquin* 1855 (GH)	Mexico: N. L., C. San Francisco
Pellaea ternifolia	29	2×	*Tryon & Tryon* 5105 (MO)	Mexico: Mor., Cuernavaca *
var. *ternifolia*	29	2×	*Rollins & Tryon* 58219 (GH)	Mexico: S. L. P., San Miguelito
(Figs. 13, 17)	29	2×	*Riba* 408 (GH)	Mexico: Pueb., Hac. Batán
	58	4×	*Tryon & Tryon* 5105 (MO)	Mexico: Mex., Valle de Bravo *
	58	4×	*Rollins & Tryon* 58218 (GH)	Mexico: S. L. P., San Miguelito
Figs. 14, 18)	58	4×	*Riba* 412 (MEXU)	Mexico: Pueb., Hac. Batán
Pellaea ternifolia	87-meiotic	3×	*Knobloch* 1624 (MSC)	USA: Ariz., Sa. Catalina mts. *
var. *Wrightiana*	87-meiotic	3×	*Knobloch* 1624 (MSC)	USA: Ariz., Sa. Catalina mts. *
	58	4×	*Wagner* 64006 (MICH)	USA: N. C., Alexander Co. *
	58	4×	*Cobean* sn. (UC)	USA: N. M , Whites City *

sample. The original magnifications of the photographs of whole spores were taken at 1000 × and portions in greater detail at 5000 ×. Spore measurements are of the greatest diameter of spores in lactic acid, including the outer perine layers. Range and mean measurements are based on samples of 100 spores — 25 from each of four collections — except for *Pellaea notabilis,* in which 50 spores were measured from each of two collections.

Measurements of the pinnae are of the longest fertile pinnae in the central portion of the lamina. Data are drawn from the revisionary study cited and additional specimens in collections of the Gray Herbarium, the Field Museum of Natural History, and the Smithsonian Institution.

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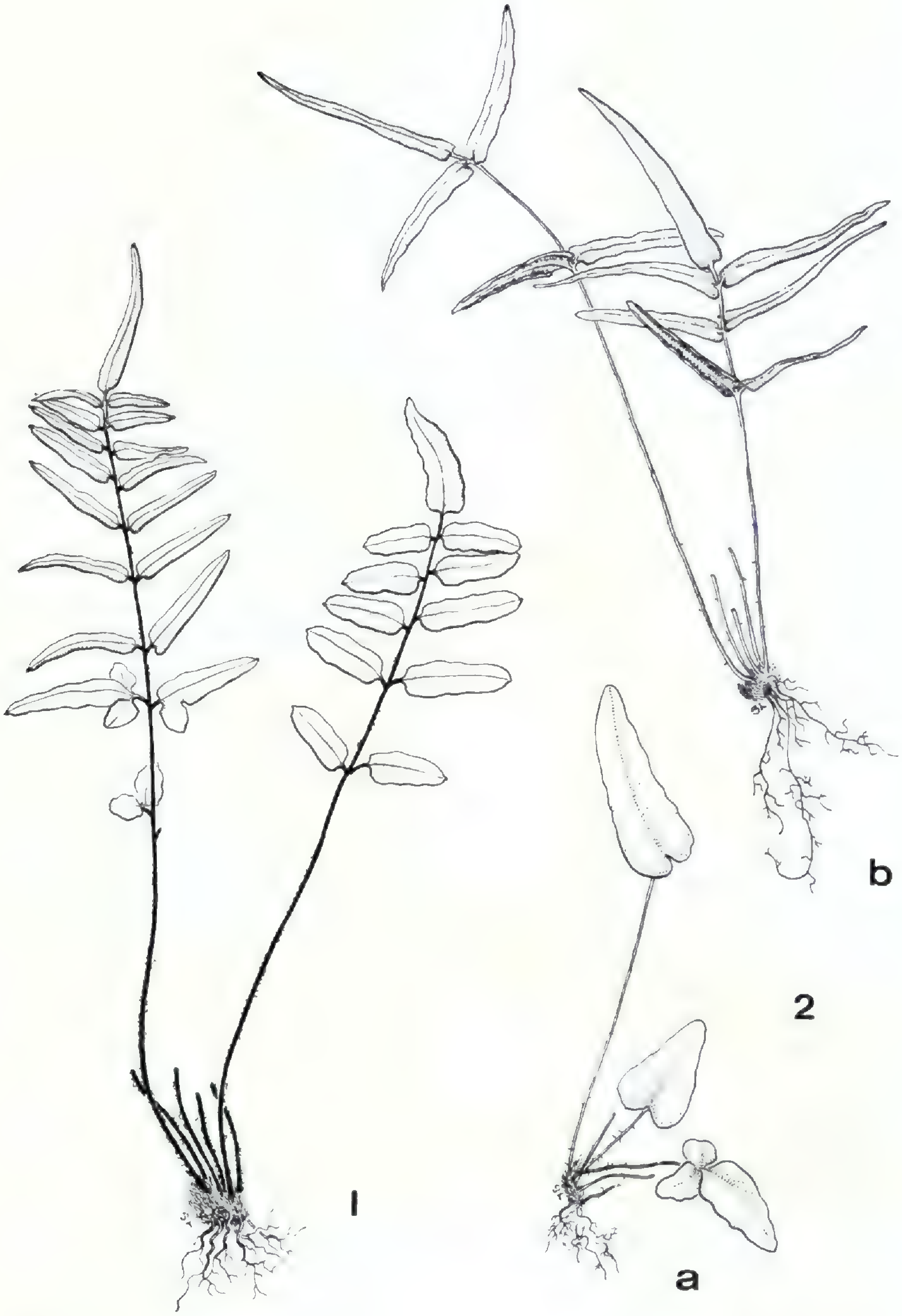
GEOGRAPHY AND ECOLOGY

The leaves of *Pellaea atropurpurea* (L.) Link are dimorphic, and several specimens from Mexico have leaves with mostly simple pinnae as in Fig. 1. The species ranges from Guatemala northward along the Sierra Oriental of Mexico, northeast across the United States to Vermont, southern Quebec and Ontario, and there are disjunct records from areas in southern British Columbia and Alberta and also north of Lake Athabaska, Saskatchewan (Fig. 3). It occurs on exposed or shaded ledges and in crevices of limestone cliffs, on talus slopes, masonry walls,



Figs. 1, 2. Habit of *Pellaea:* Fig. 1. *P. atropurpurea* with leaves of most simple form, Puebla, *Arsène* 3548 (GH); Fig. 2. *P. notabilis* with dimorphic leaves, Nuevo Leon, *Knobloch* 1963, (GH), a. Young plant, b, Fertile leaves on mature plant; both from spores. All × ½.

or in rocky loam in woods, at 300-3200 meters. At its southernmost station in Guatemala it grows in crevices of ancient Indian pyramids. At Campbell's Bay, in Quebec, near Ottawa, it occurs on precambrian rocks in which limestone is incorporated. In Ontario it is reported by Rigby (1968) to occur in sheltered locations on talus or limestone paving, rather than exposed cliffs.

Leaves of mature plants of *Pellaea notabilis* Maxon are usually dimorphic and the pinnae simple. The first leaves are entire and cordate, and the older ones rarely have a compound lamina as in Fig. 2. Collections are known from the vicinity of Victoria, Tamaulipas, at 320 m. and from Nuevo Leon (Fig. 3). In the latter state it grows on calcareous rocks at 1100 m. in San Francisco canyon, south of Monterrey, and *P. atropurpurea* has also been collected there. Plants of *P. notabilis,* grown from spores of two collections from this canyon, produced fertile leaves in six months. The rapid and vigorous growth of these plants in culture suggests that some external factors are responsible for the limited distribution of the species.

Pellaea ternifolia (Cav.) Link car. *ternifolia* is the widest ranging of all the American pellaeas occurring from southern Texas to Argentina and Hawaii, at 200-4000 m. Both diploids and tetraploids (Figs. 5, 6) are known in the variety, and both occur at the same localities in the states of Durango and Michoacán as well as the stations reported here. Ecological data from these collections as well as field observations show that the tetraploids grow in more shaded, wetter sites than the diploids. The localities for the three cytologically documented plants are shown on the map of the general range of the variety in continental North America (Fig. 7). In addition to these tetraploids other specimens which are morphologically similar, including those reported by Pray (1967) from Mexico and Texas, are included on the map.

The leaves of *Pellaea ternifolia* var. *Wrightiana* (Hook.) A. Tryon (Fig. 4) most closely resemble the form of the diploids in var. *ternifolia,* and variation in these is noted

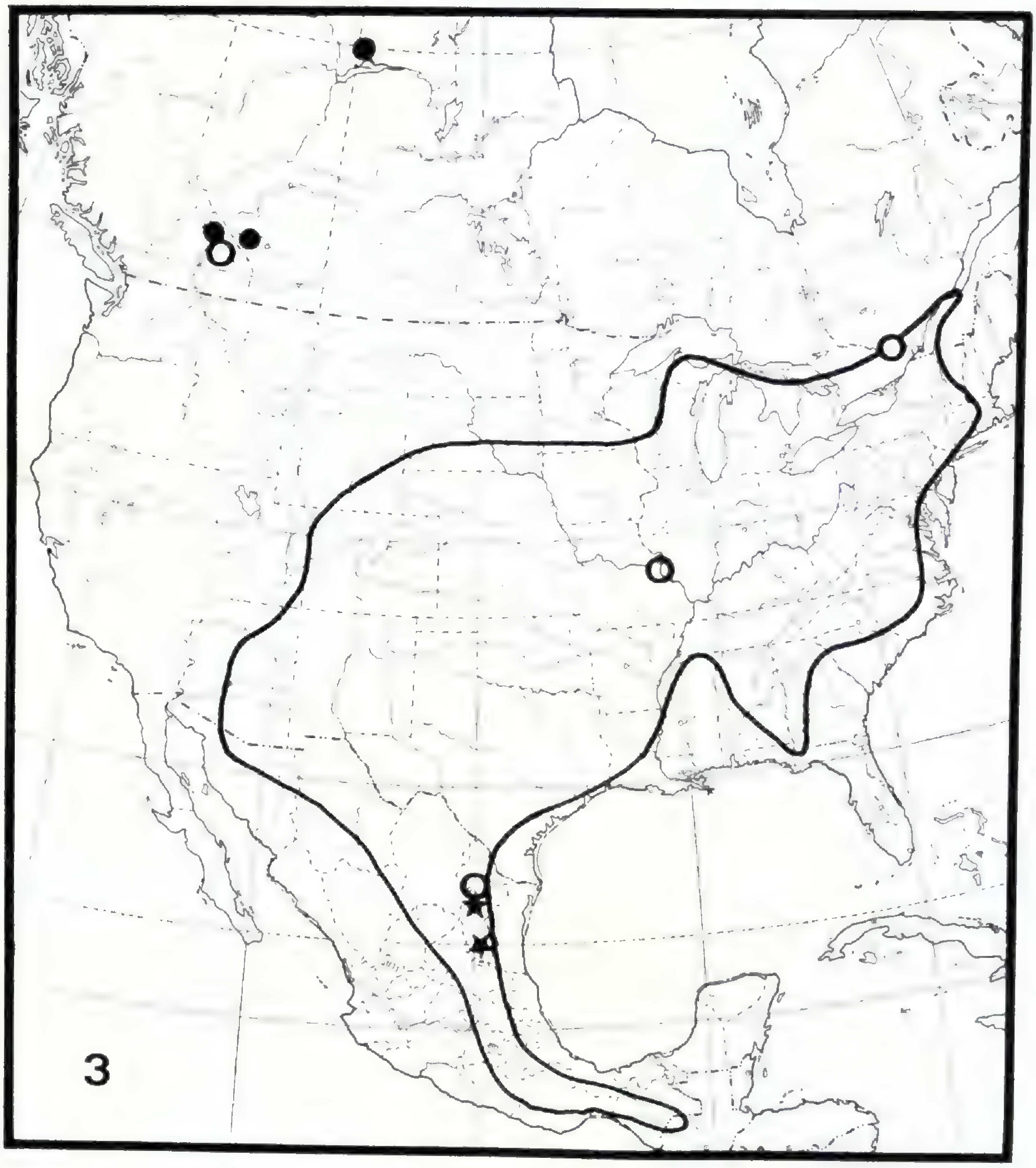
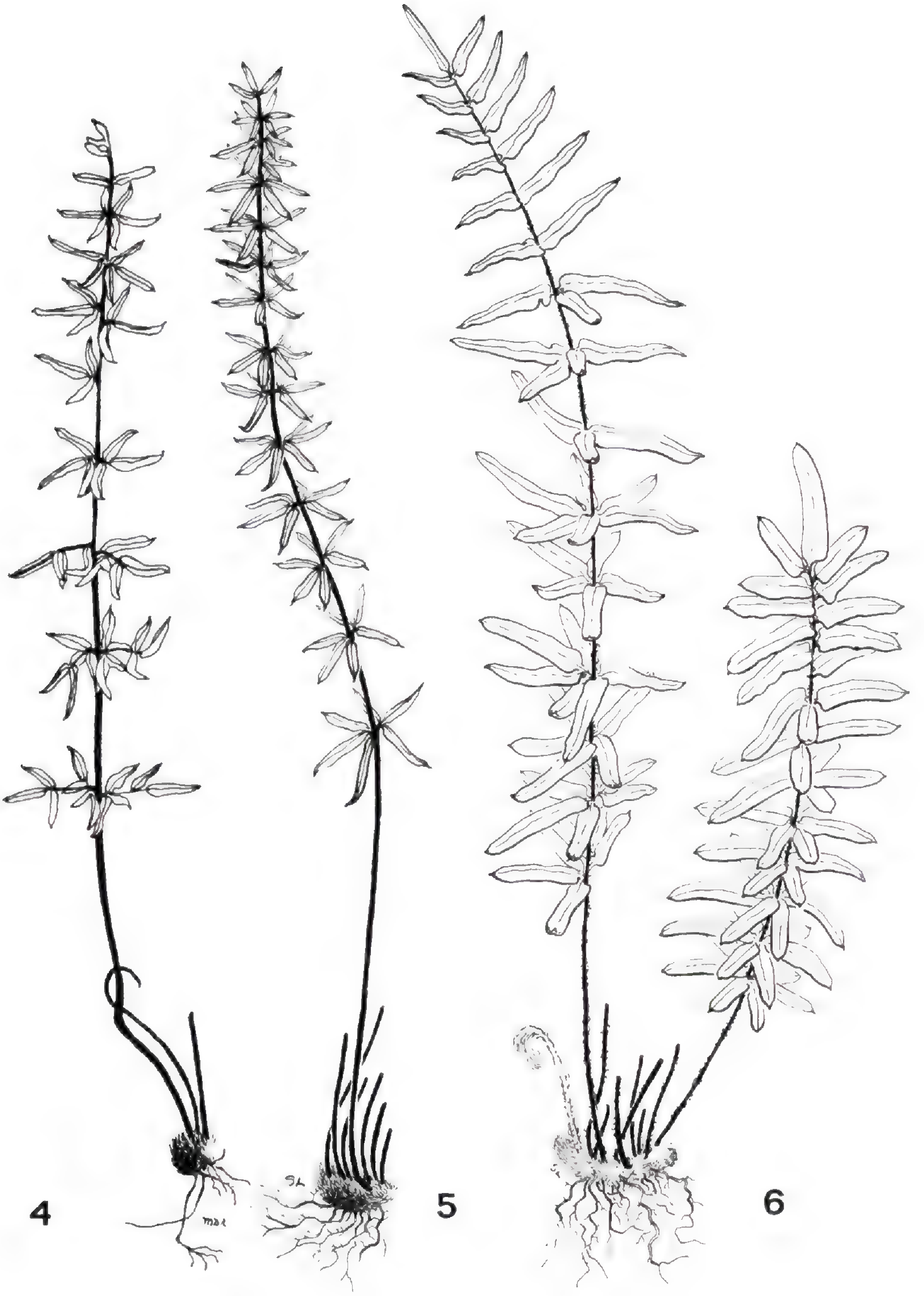
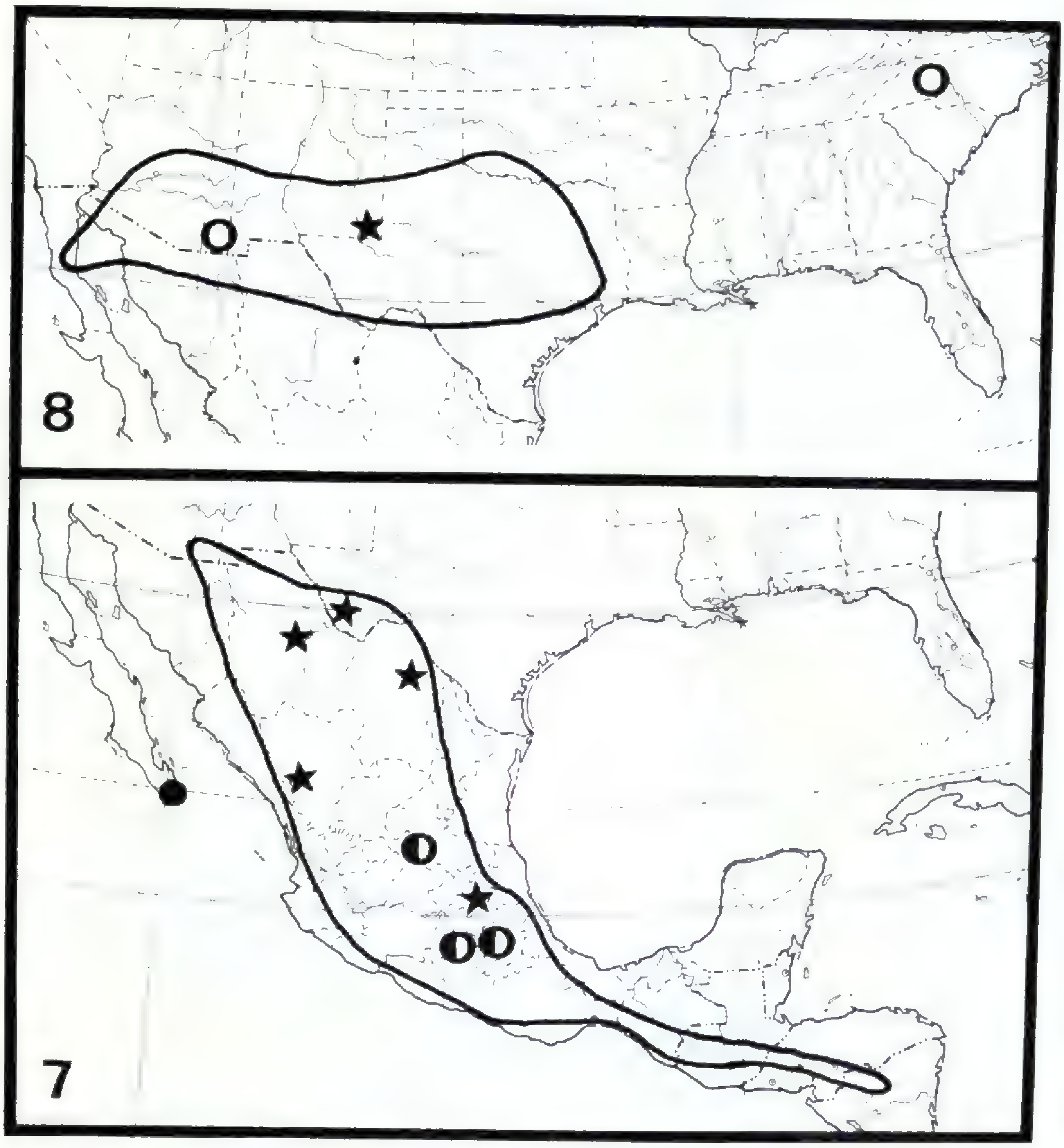


Fig. 3. *Pellaea atropurpurea* and *P. notalilis: P. atropurpurea* outlined dots-disjunct stations, circles-cytological records; *P. notabilis* stars-the upper a cytological record.



Figs. 4-6. Habit of *Pellaea ternifolia:* Fig. 4. var. *Wrightiana*, Burro mts., New Mexico, *Rusby* in 1880 (GH); Figs. 5, 6. var. *ternifolia:* Fig. 5. Diploid, Puebla, *Riba* 408 (GH). Fig. 6. Tetraploid from culture, San Luis Potosí, *Rollins & Tryon* 58218 (GH). All × ½.

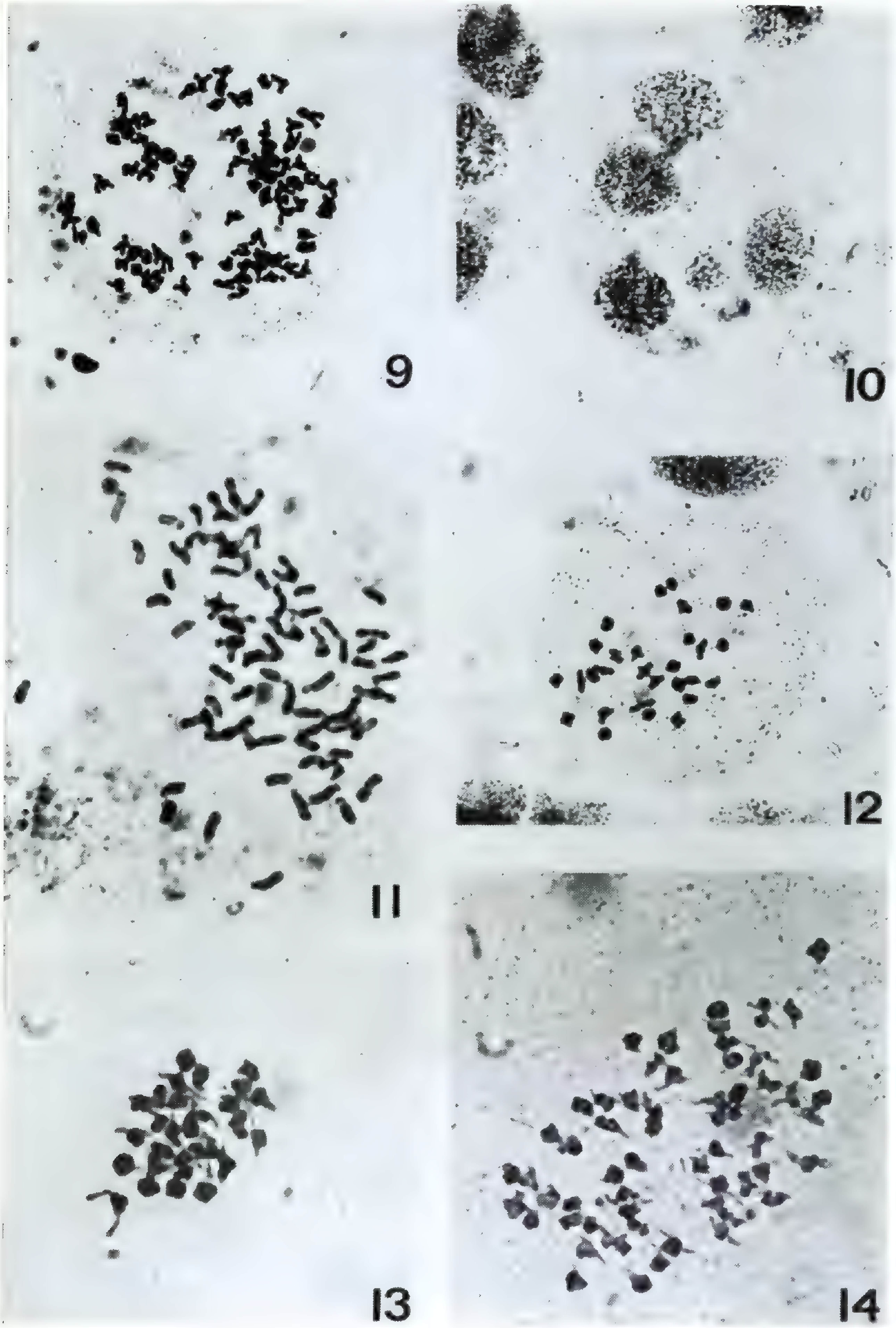


Figs. 7, 8. Range of *Pellaea ternifolia:* Fig. 7. var. *ternifolia* outlined, dot-disjunct station, stars and circles-tetraploids, circles-cytological records, half circles-localities of both diploids and tetraploids; Fig. 8. var. *Wrightiana*, circles-tetraploids, star-triploid.

in the section under morphology. The geographic range of var. *Wrightiana* extends from southern Oklahoma southwest to Arizona and across the Mexican border in northern Chihuahua, Coahuila and Baja California, at 1400-2300 m. (Fig. 8). A disjunct station is also reported about 1000 miles eastward in Alexander Co. in western North Carolina. This latter record may indicate a formerly more continuous distribution of these plants across the southern United States similar to the present range of *P. atropurpurea*, or possibly long distance dispersal from populations farther west. Specimens are mostly from exposed situations, among sandstone or granitic rocks or rarely on limestone. A few collections of somewhat larger specimens are from shade, in moist forested sites.

CYTOLOGY

Mitosis and meiosis were examined in plants of *Pellaea atropurpurea* from Chipinque Mesa, south of Monterrey, Mexico. In the mitotic cells many chromosomes have subterminal centromeres as shown in Fig. 11. Differences in the position of centromeres, in chromosome size, and the occurrence of satellites, are diagnostic aspects useful in karyotype analyses. In these apogamous plants most sporangia have eight spore-mother-cells, and some sixteen-celled sporangia are also formed. In meiotic nuclei, the nucleoli are conspicuous and persist through diakensis. Their structure can be distinguished from the bivalents in Fig. 9 by the circular form and lighter stain. In the eight-celled sporangia the chromosomes are usually associated in bivalents (Figs. 9, 16), and this is also reported by Manton (1950) and Rigby (1968). In apogamous plants the chromosome number in sporangia with eight spore-mother-cells, according to Manton, undergoes premeiotic doubling to accommodate reduction. In sixteen-celled sporangia, at meiosis, Manton (1950) and Britton (in Tryon & Britton, 1958) report approximately 29 pairs and 29 single chromosomes. The pairing associations in several cells from both types of sporangia were studied by Rigby. In these, two cells from sixteen-celled sporangia (a specimen from Que-



Figs. 9-14. Meiotic and mitotic nuclei: Figs. 9-11. *Pellaea atropurpurea:* Fig. 9. Nucleus from 8 celled sporangium with 87 bivalents, the nucleolus at upper right, × 660; Fig. 10. Early stage in sporogenesis, micronucleus and 4 nuclei at center, × 600; Fig. 11. Mitotic chromosomes from young sporangium. All triploid, $n=87$, *Rollins & Tryon* 5860 (GH). Fig. 12. Meiosis, *P. notabilis*, diploid, $n=29$ Marroquin 1855 (GH) × 660. Figs. 13, 14. Meiosis, *P. ternifolia* var. *ternifolia:* Fig. 13. Diploid *P. ternifolia* var. *ternifolia;* Fig. 13. Diploid, $n=29$, *Riba* 408 (GH) × 1000; Fig. 14. Tetraploid, $n=58$, *Riba* 412 (MEXU) × 1000.

bec) had equal numbers of pairs and univalents, but one had nine and the other six trivalents. A second collection (from British Columbia) had 31 bivalents, 22 univalents and one trivalent. Affinities between the parental genomes are expressed in these cells by the associations of more than 29 bivalents and also the trivalent formations. The variations in chromosome associations in these cells and also the lack of multivalents in the eight-celled sporangia, which have doubled the chromosome number, raise problems in the interpretation of chromosome pairing in these plants. There are frequent irregularities as shown in the early stage of sporogenesis in Fig. 10, in the sixteen celled sporangia, with an extra micronucleus.

Two collections of *Pellaea notabilis* from Nuevo Leon uniformly had 29 bivalents at meiosis as in Figs. 12, and 15. This establishes the species as a diploid with the basic chromosome number for *Pellaea.* The number is consistent with the species being proposed as one of the elements involved in the origin of the triploid *P. atropurpurea.*

Both diploid and tetraploid plants of *Pellaea ternifolia* var. *ternifolia* were studied from the same localities near San Luis Potosi and also farther south near Puebla. There are earlier records of these two polyploid levels, reported by Britton, from localities near Mexico City but not at the same site. The diploid with 29 bivalents and the tetraploid with 58, in Figs. 17, 18 are collections from Puebla. Contrast in the number of bivalents at late metaphase in these two polyploid levels is readily apparent in the figures. The terminal portions of the chromosomes in the centromeric regions in Figs. 13, 14 are stretched thinner than the remainder of the chromosomes forming the bivalents. These attenuated portions show tension on the late metaphase chromosomes as they prepare to move to the poles. The tetraploid plants generally resemble the diploids, but the pinnae tend to be entire and the rachises more pubescent (Figs. 5, 6) as compared to the diploids, which have ternate pinnae and nearly glabrous leaves. The drawing of the tetraploid in Fig. 6 represents an especially robust plant

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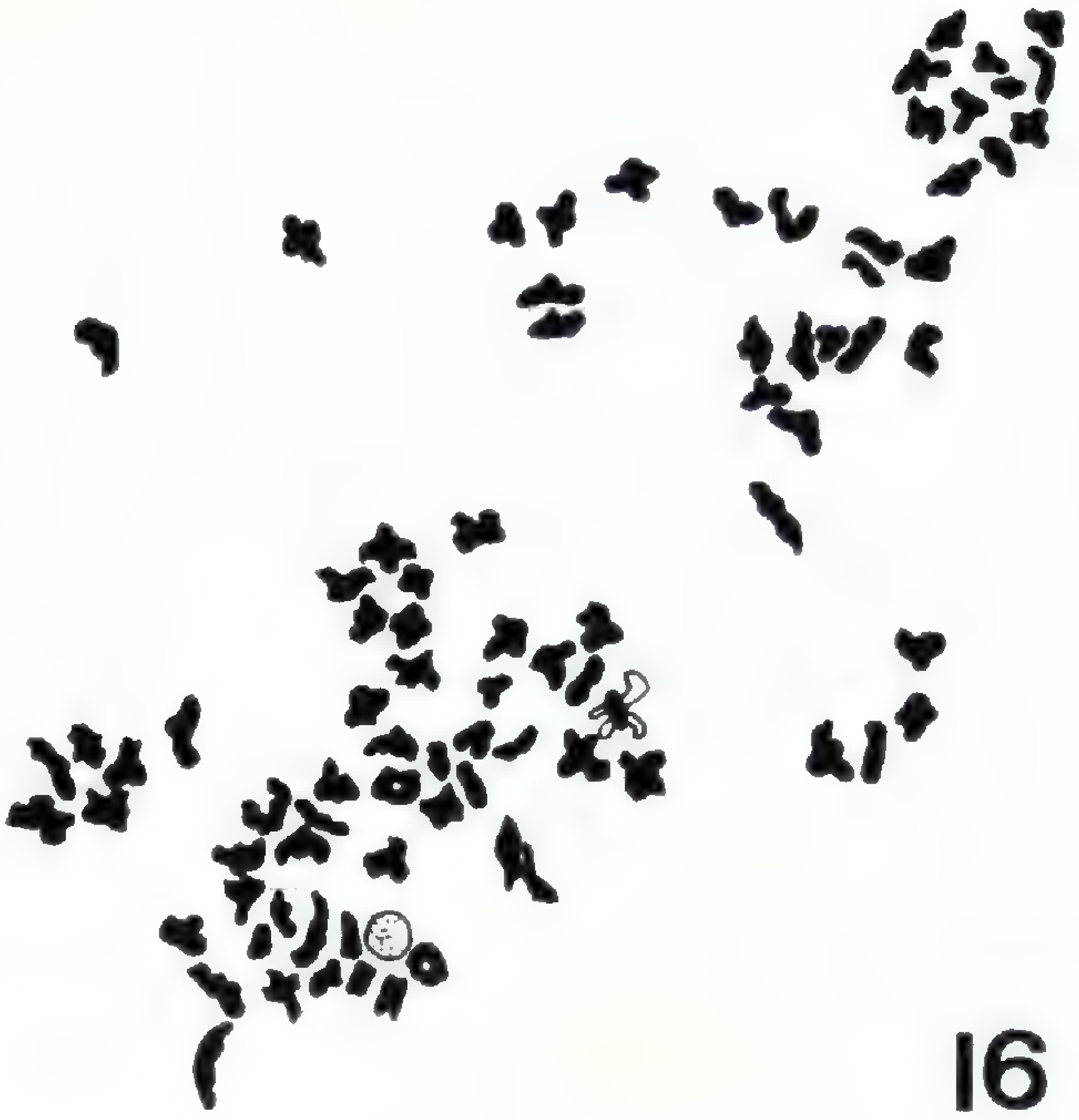


16

17

18

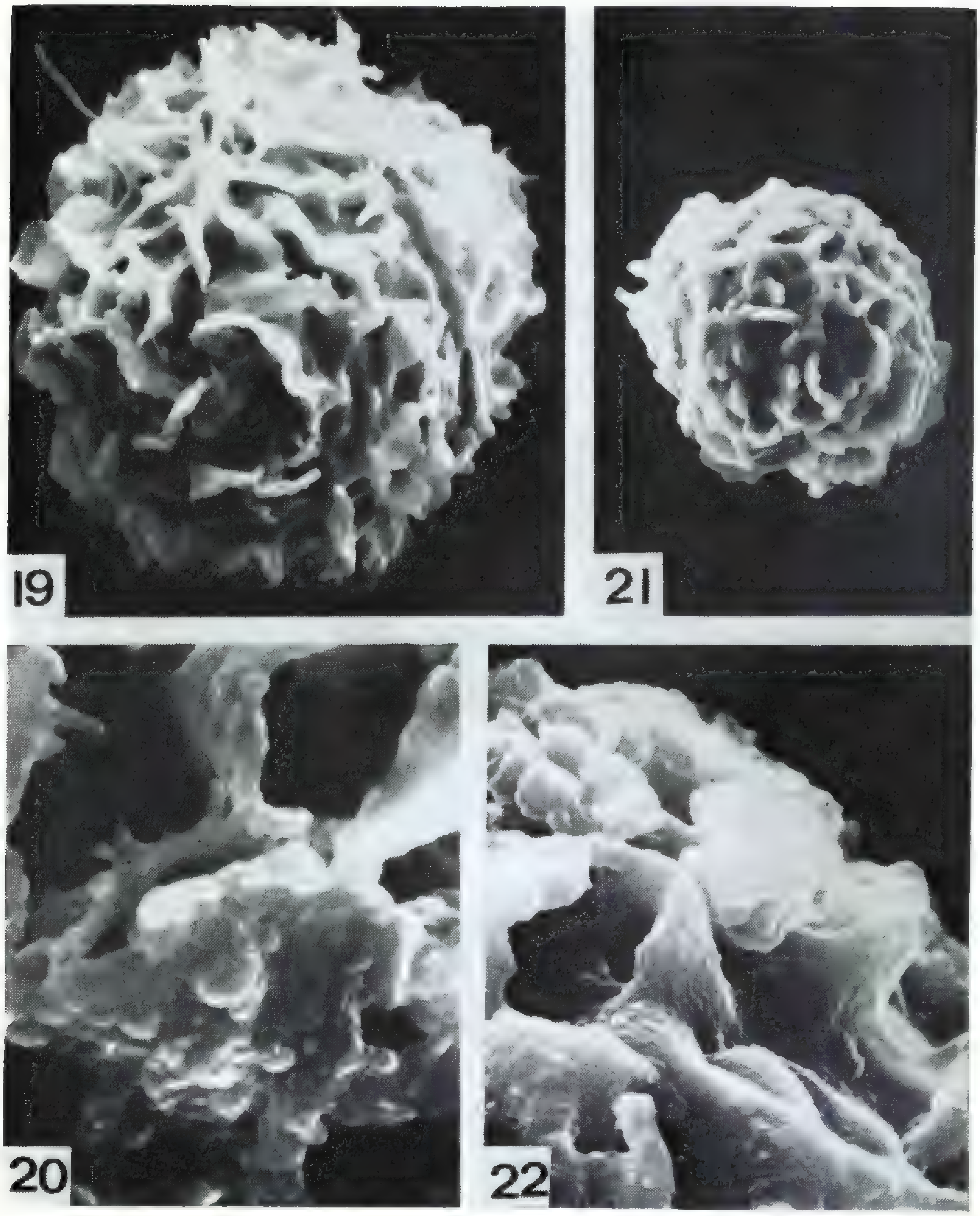
Figs. 15-18. Explanatory diagrams of meiotic nuclei (Figs. 9-14) showing bivalents in focus in black, others in outline, nucleolus stippled, from the same cells except *P. atropurpurea:* Fig. 15. *P. notabilis,* Fig. 16. *P. atropurpurea,* $n=87$, *Rollins & Tryon* 5860 (GH); Figs. 17, 18. *P. ternifolia* var. *ternifolia* with thin portions omitted: Fig. 17. Diploid, Fig. 18. Tetraploid.

that was grown in culture for several months. At Hacienda Batán, near Puebla, the tetraploids are rare, occurring in moist, shaded places while the diploids grow in exposed, rocky crevices. Other specimens, which appear to be tetraploids on the basis of the characters noted above, are quite widely distributed as is shown by the stars on the map in Fig. 7.

The cytological records of *Pellaea ternifolia* var. *Wrightiana* are based on three earlier reports from localities in the United States. Tetraploids with $n = 58$ were noted from the western part of the range in New Mexico by Lloyd (1968) and from the disjunct station in North Carolina by Wagner (1965). These plants were considered to be amphiploid hybrids of the diploids *P. ternifolia* var. *ternifolia* and *P. truncata* Goodd. (*P. longimucronata* Hook.). A triploid plant of var. *Wrightiana* with 29 bivalents and 29 univalents from Arizona was reported by Knobloch & Britton (1963). This plant was considered to have originated as a hybrid between the diploid *P. truncata* and a tetraploid plant of var. *ternifolia*. Knobloch & Britton report the same chromosome number in both mitotic and meiotic cells and also 64 irrgular spores in the sporangia. A specimen (*Pringle*, May 6) from the Santa Catalina mountains, which also appears to be a variant as noted in the survey of the spores, indicates the need for further cytological sampling of var. *Wrightiana*.

SPORES

In *Pellaea atropurpurea* only spores of the 32-spored sporangia mature, and this reduced number reflects the apogamous type of reproduction. The spores are globose or somewhat ellipsoidal (Fig. 19) and unusually large, ranging from 54-92 μ in diameter. The triradiate scar scarcely projects, and is apparent only in cleared material, with arms extending ¾ or more of the radius. The perine ridges are similar to those in *P. notabilis* but are sharper and more prominent. At higher magnification the perine surface consists of compacted sporopollenin particles (Fig. 20).

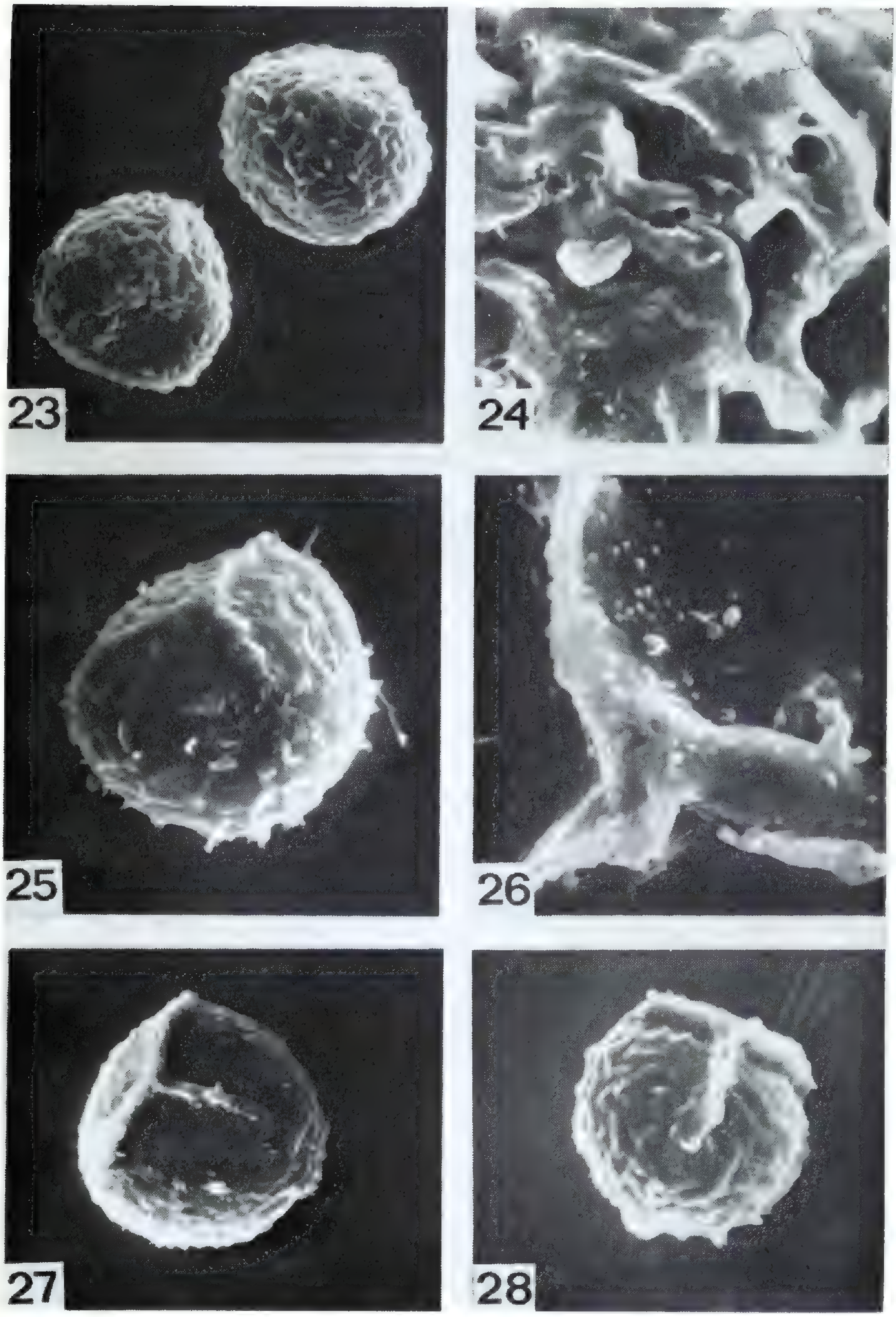


Figs. 19-22. Spores of *Pellaea:* Figs. 19, 20. *P. atropurpurea:* Fig. 19. Nuevo Leon, *Rollins & Tryon* 5860 (GH), × 660; Fig. 20. Perine surface, Hac. Batán, *Arsène* 3548 (GH), × 3300. Figs. 21, 22. *P. notabilis:* Fig. 21. *Knobloch 1963* (GH), × 660; Fig. 22. Perine surface, × 3300.

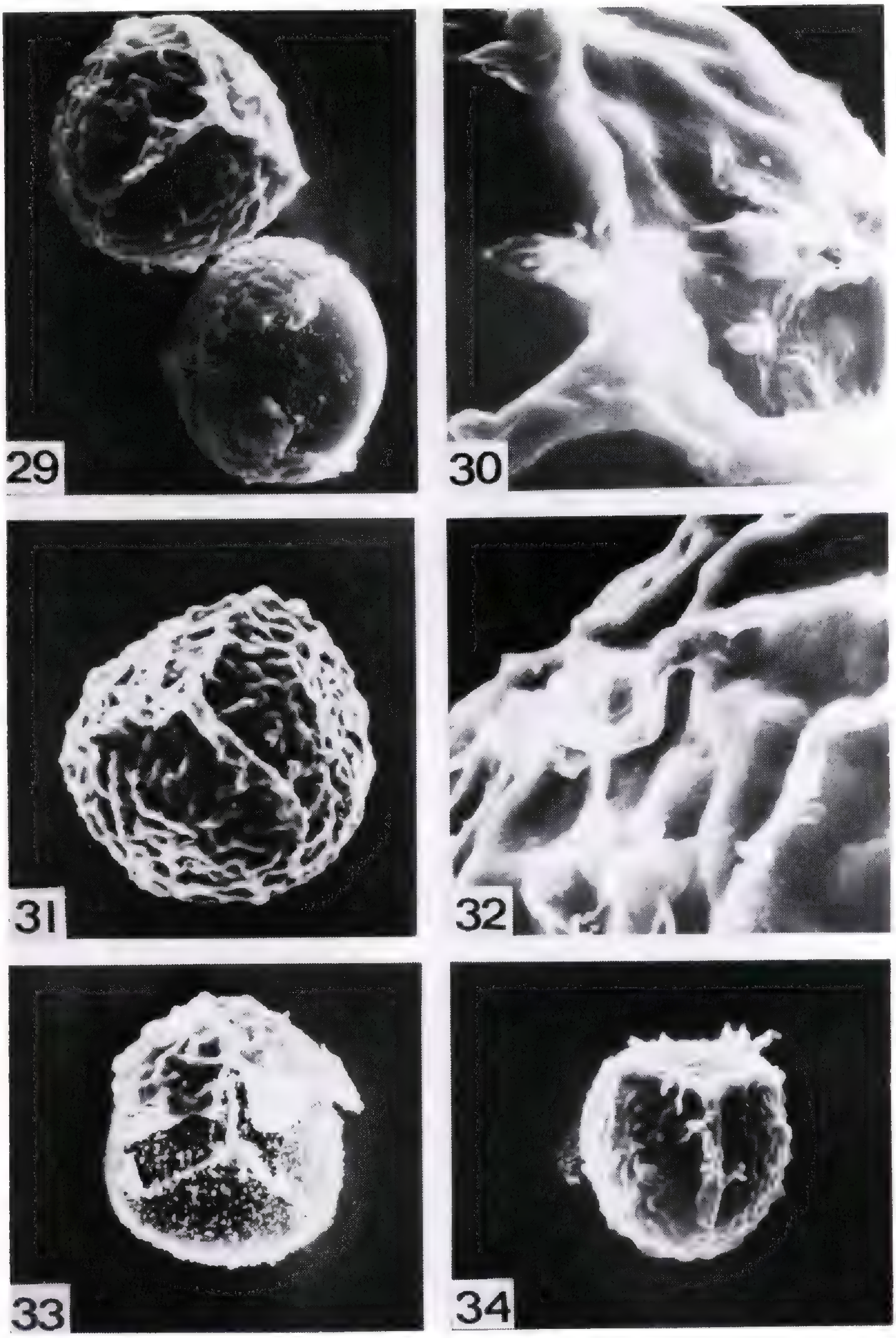
In *Pellaea notabilis* sporangia have 64 well formed spores that are globose or somewhat ellipsoidal (Fig. 21) and range from 40-62 μ in diameter. The slightly larger spore size in this diploid, relative to diploid spores in *P. ternifolia* var. *ternifolia*, may be partly due to the inclusion of the prominent ridges in the measurements. These dense ridges obscure the triradiate scar, but in cleared material it projects slightly and the arms extend ¾ of the spore radius. At higher magnification the perine deposition appears uniformly verrucate on both floor and ridge surface (Fig. 22).

In both diploid and tetraploid forms of *Pellaea ternifolia* the sporangia uniformly have 64 spores. Those of the tetraploid are consistently larger, ranging from 46-62 μ as compared to the diploids which range from 38-58 μ. The size differences are especially apparent in Figs. 23 and 25 and have been reported also in other collections by Pray (1968). Spore shape is generally spherical or tetrahedral-globose especially in the tetraploid which has broader surfaces between the arms of the triradiate scar. These arms extend ¾ or more of the spore radius. The perine is generally similar in spores of both polyploid levels, but variation occurs in density and prominence of the ridges. These may be especially prominent in the diploid spores (Fig. 24), and on the smoother surface of the tetraploid spores (Fig. 26) there are often numerous sporopollenin particles.

Spores of *Pellaea ternifolia* var. *Wrightiana* were examined from populations throughout its range. Sporangia usually have 64 spores of relatively uniform size. A specimen (Pringle, May 6, 1883, GH) collected in the Santa Catalina mountains in Arizona had many irregular spores and some small ones as shown in Fig. 34. This specimen may represent another triploid, similar to that reported from the same area by Knobloch and Britton (1963). The spores of var. *Wrightiana* are usually globose with a prominent triradiate scar extending ¾ or more of the spore radius. The form of the perine is relatively uniform as



Figs. 23-28. Spores of *Pellaea ternifolia:* Figs. 23-26. var. *ternifolia:* Fig. 23. Diploid, × 660; Fig. 24. Perine surface, × 3300, both San Luis Potosí, *Rollins & Tryon* 58219 (GH); Fig. 25. *Tetraploid,* × 660; Fig. 26. Perine surface with portion of triradiate scar, × 3300, both *Rollins & Tryon* 58218 (GH); Figs. 27, 28. var. *Wrightiana:* Fig. 27. Gillispie Co., Texas, *Correll & Correll* 12762 (GH), × 660; Fig. 28. Santa Catalina mts. Arizona, *Phillips & Reynolds* 2943 (GH), × 660.



Figs. 29-34. Spores of *Pellaea ternifolia* var. *Wrightiana:* Fig. 29. Lower spore with portions of perine eroded, smooth exine surface at right, × 660; Fig. 30. Perine surface with portion of triradiate scar, × 3300, both, Coahuila, *Johnston & Miller* 1309 (GH); Figs. 31-33. Alexander Co., North Carolina, *Bozeman* et al. 45152 (SIU): Fig. 31. × 660, Fig. 32. Perine surface, × 3300, Fig. 33. Spore with partly eroded perine and subtending scabrous layer, × 660, Fig. 34. Santa Catalina mts., Arizona *Pringle*, May 6, 1883 (GH), × 660.

shown in the series of specimens from Mexico, Arizona, Texas, and North Carolina (Figs. 27-34), although there is some variation in size and prominence of the perine. The specimens from North Carolina have an especially rugose perine with stratification as shown in Fig. 33, showing a coarse outer rugose layer subtended by a strongly scabrous one. Similar stratification is also evident in the specimen from Mexico in Fig. 29, which has some scabrous deposition on the smooth surface of the spore exine where the perine has been abraded.

The differences in prominence of the triradiate scars in these species may imply distinctions in spore development. The prominent triradiate scars with scant perine deposition characteristic of the spores of *P. ternifolia* indicate that these may have stronger tetrad associations. In contrast to these, the obscure triradiate scars in *P. notabilis* and *P. atropurpurea* suggest the tetrads may be disassociated before completion of the perine deposition.

MORPHOLOGY

Comparisons of the morphology of the species and varieties are made in Table 2. Similarities between *Pellaea notabilis* and *P. atropurpurea* (Figs. 1, 2) are especially evident in the dimorphic leaves, terete shape of the petiole, longer pinnae, and concolorous rhizome scales. These two species are readily distinguished from *P. ternifolia* by these characters. There are also marked similarities among the three kinds of *P. ternifolia* (Figs. 4-6) in the petiole shape, monomorphic leaves, and bicolorous rhizome scales. The form of the perine, in addition to the characters shown in the chart, also establishes a close relationship among them. These similarities express relationships that, by comparison to other species of *Pellaea*, can appropriately be recognized by including them in a single species.

Morphological variation in collections of *Pellaea ternifolia* var. *Wrightiana* was surveyed over the whole geographic range. Most of the specimens have leaves most closely resembling the form of the diploid var. *ternifolia* (Figs. 4, 5). Some variation is shown in the division of the leaves,

TABLE 2. MORPHOLOGICAL COMPARISONS OF THREE SPECIES OF PELLAEA

				ternifolia	
	notabilis	*atropurpurea*	*var. Wrightiana*	*var. ternifolia* 2×	*var. ternifolia* 4×
Leaves	dimorphic	dimorphic	monomorphic	monomorphic	monomorphic
Lamina shape	deltoid or elongate-ovate	elongate-triangular	narrowly triangular	linear or narrowly lanceolate	linear or narrowly lanceolate
division	1 pinnate	1-3 pinnate	2 pinnate	1 pinnate	1 pinnate
Pinna length	3-7 cm.	1-12 cm.	1.0-4.5 cm.	0.5-4.0 cm.	1.7-4.0 cm.
central segment number	1	1-15	3-11	mostly 3, to 1	1-3
Petiole color	tan, atropurpureus at base	atropurpureus, rarely castaneus	castaneus	castaneus or atropurpureus	atropurpureus
shape	terete	terete or elliptical	plane on adaxial surface	plane on adaxial surface	plane on adaxial surface
indument	slightly pubescent	pubescent, hispid	glabrous or sparsely pubescent	glabrous or sparsely pubescent	lanate especially at apex
Spore size-(mean)	40-62 μ (50)	54-92 μ (64)	34-56μ (49)	38-58 μ (46)	46-62 μ (54)
Rhizome scales	concolorous, tan or rusty	concolorous, tan or rusty	bicolorous, rusty, broad central sclerotic stripe	bicolorous, tan, narrow central sclerotic stripe	bicolorous, tan, broad central sclerotic stripe

especially on the same plant, and this appears to be correlated with leaf size. In these specimens the leaves with shorter pinnae rachises and nearly ternate pinnae, resembling those of var. *ternifolia,* are usually smaller and seem to be produced before the more highly divided leaves resembling those of *P. truncata.* A similar correlation between leaf size and division is also evident in the plant from North Carolina figured by Wagner (1965). Thus, variation in leaf form in plants of var. *Wrightiana* shows types intermediate between var. *ternifolia* and *P. truncata* and also differences in developmental sequence.

DISCUSSION

The report of 29 bivalents in *Pellaea notabilis* establishes this as one of the basic species among the American pellaeas. Similarities of the spores and other morphological characters indicate that it is probably one of the elements involved in the origin of the widely distributed triploid, *P. atropurpurea.* On the basis of this new information several possibilities may be considered for the origin of *P. atropurpurea.*

The strong morphological resemblances between the two species suggest that *Pellaea atropurpurea* may be an autoploid of *P. notabilis.* The triploid could have originated from two gametes of *P. notabilis,* one of them unreduced. The studies of *P. atropurpurea* by Rigby show that affinities do exist in the two parental genomes.

However, several unique characters of *Pellaea atropurpurea* must also be considered. The broad leaves up to three times pinnate with densely pubescent rachises suggest that a second distinctive parent is involved in addition to *P. notabilis.* The cytological and morphological survey of *P. ternifolia,* the most likely parent in northern Mexico, shows that none of its variants completely fills the morphological requirements of the second parent. The spores of *P. ternifolia* are especially diagnostic, and the perine form is quite different from that of *P. atropurpurea.* The unique morphological features of *Pellaea atropurpurea* are inconsistent with an autoploid origin from *P. notabilis,* and

the characters of its closest relatives near the present range of that species are inconsistent with an amphiploid origin involving one of them. The most reasonable conclusion at this time is that either the second parental element of *P. atropurpurea* belongs to another species group possibly not within the geographic center, or it may be extinct. The rare occurrence of *P. notabilis,* its closest relative in northern Mexico, suggests that the other parent may no longer be extant.

The extensive distribution of *P. atropurpurea* is undoubtedly partly based on the absence of syngamy. Elimination of the conditions required for fertilization results in more broadly adapted apogamous gametophytes. The large spores may also provide additional reserves, increased survival capacity, and a greater energy source for more rapid development of apogamous gametophytes and sporelings. In *Pellaea ovata* (Desv.) Weath., which has both a sexual ($2x$) and an apogamous ($3x$) race, the range of the latter is over 4000 miles greater than that of the sexual race. The effectiveness of the apogamous reproductive system is shown by the wider geographic distribution of the apogamous race in that species as well as in *P. atropurpurea.*

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THE GENUS CORIARIA (CORIARIACEAE) IN THE WESTERN HEMISPHERE[1]

LAURENCE E. SKOG

With the recent awakening of research in hallucinogenic plants, some attention has been given to the genus *Coriaria*. Plants of this genus are known to be toxic to animals when taken internally, as well as being hallucinatory in small quantities. Studies of its toxicity and the application of the toxic elements in treatments of barbituate poisoning have made necessary a basic taxonomic study of *Coriaria*.

This paper deals with taxonomic studies of the plants which occur in the Western Hemisphere. *Coriaria* inhabits warm temperate regions of southern South America, and, in the tropical areas, high elevations of the northern Andes, ranging north through Central America to the Sierra Madre Occidental in Mexico. *Coriaria* is known also from southern Europe, North Africa, the Himalayas, islands of the Pacific coast of Asia and the western Pacific Ocean, including New Zealand. The genus makes an interesting study of geographical distribution and dispersal which has resulted in highly disjunct populations. The plants of the Western Hemisphere have close relatives on the other side of the Pacific Ocean, but these are excluded from consideration here.

PHYLOGENY OF THE GENUS

As the only genus in the family Coriariaceae, *Coriaria* has no close relatives and no close morphologic affiliation with any other family. In 1816 De Candolle placed *Coriaria* in the Rhamnaceae. Since that time the position of *Coriaria* in a phylogenetic system has changed often with various authors, ranging from alliances with the Urticaceae (Maximowicz, 1881) to a much more advanced position near the Araliaceae (Russow, 1884). Most often the genus has been

[1]Based on a thesis submitted to the Graduate School of the University of Connecticut in partial fulfillment of the requirements for the degree of Master of Science.

placed near the Anacardiaceae as was done by Bentham and Hooker in 1862. Hutchinson in 1964 placed *Coriaria* in its own order, Coriariales, between the Dilleniales and the Rosales, and derived from the former. Cronquist (1968), with a note of doubt, has placed the Coriariaceae in the Ranunculales.

The phylogenetic relationships of the Coriariaceae cannot be determined accurately without, perhaps, the discovery of some "pre-Coriaria" which would link the family to another group. It is apparently not closely related to any single other family; it has long been distinguished and kept separate from other families and probably should not be closely associated with others in the same order. There is, however, no single character of the family that sets it apart, but a combination of traits. If the dicots are viewed as polyphyletic, *Coriaria* could be one of the distinct lines which branched from the main line of evolution sometime in the Cretaceous, retaining many primitive characters while evolving other more advanced or specialized traits.

If one lists the characteristics of dicotyledonous families and then attempts to place a family among them, correlations become evident which can sometimes be interpreted as showing evolutionary relationships; with *Coriaria* this has not been successful. Various characters of dicots are considered as being either primitive or advanced. These often determine the position of the family in a phylogenetic order. Maximowicz (1881) attempted to draw conclusions about relationships by using morphological characters of various families, then weighting them as to their importance in *Coriaria*. After totaling the values, Maximowicz concluded the genus was most closely allied to the Simaroubaceae, and also had affinities with the Phytolaccaceae. If one had to select another family in which *Coriaria* could be placed, one might choose the Rosaceae. The characters of *Coriaria* fall within the broad limits of this family, as defined or delimited by Lawrence (1951) and Hutchinson (1964). Within the Rosaceae, though, there is no single genus to which *Coriaria* is closely related. The genus fits

less well in the Simaroubaceae or Erythroxylaceae, and only superficially in the Brunelliaceae. Paralleling this viewpoint, Hutchinson has placed *Coriaria* in a distinct order between the Brunelliaceae and Rosaceae, and Hallier (1905) placed the Coriariaceae in the Rosales, but allied to the Simaroubaceae.

TAXONOMY

Coriaria L., Genera Plantarum, ed. 5. 459. 1754. Type: *Coriaria myrtifolia* L.

Heterocladus Turcz., Bull. Soc. Imp. Naturalistes Moscou **20**: 152. 1847. Type: *H. caracasanus* Turcz. *Non Heterocladia* Dnd. as *Hererocladia* Dnd. *ex* Turcz., *sphalm. ex* Jacks.

Heterophylleia Turcz., Bull. Soc. Imp. Naturalistes Moscou **21**: 591. 1848. Type: *H. caracasana* (Turcz.) Turcz.

Subshrubs to small trees. Roots fibrous, with prominent nitrogen-fixing nodules. Stems rhizomatous, the branches sharply quadrangular, becoming terete, eventually arching to pendulous, the lenticels corky. Clusters of axillary buds produced in the axils of the leaves of the main axes. Leaves simple, whorled to opposite, appearing distichous through alternate twisting of the branches, often approximate above, short-petiolate to subsessile, the minute stipules withering and persistent or caducous, the blades palmately veined, lanceolate to ovate, entire, cordate, truncate to rounded at the base, the apex rostrate to mucronate. Racemes erect to pendent, terminating main or lateral axes. Flowers small, basically pentamerous, actinomorphic, or the calyx slightly zygomorphic, perfect, polygamo-monoecious, andromonoecious or appearing so through marked proterogyny, hypogynous, green, red or dark purple, the pedicels ebracteolate to several-bracteolate, the sepals at fertilization, but accrescent and prominently fleshy subulate, persistent, the petals distinct, shorter than the sepals at fertization, but accrescent and prominently fleshy in fruit, ultimately black, red or yellow, stamens 10 in two

whorls, with filiform filaments 2 mm. long, each anther sagittate, smooth to verruculose, 4-celled, dehiscing by longitudinal slits, the pollen spheric, 3-colporate, pistils 5 to 10 (-12), distinct, simple, the styles fasciculate and strict or divergent, papillose and stigmatic over their entire surfaces. Ovule solitary, pendant. Fruits dorsally keeled achenes, each bilaterally compressed, all enclosed by the fleshy accrescent petals. Seeds with a single membranous testa and scanty endosperm.

Key to the species and subspecies of *Coriaria*. (All known species included here for completeness.)

a. Bases of lateral branches nearly always without bud scales; inflorescences produced terminally, either on the main stem or on branches, but on the current flush of growth; racemes sparsely to very densely pubescent; bracts subtending the flowers lanceolate to elliptic, entire; flowers strictly perfect; inner whorl of stamens free; achenes 1 to 2 mm. long. (b)

b. Stems herbaceous, dying to the ground following maturation of fruits; leaves of the flowering axes ovate to suborbiculate, with 7 to 9 main basal veins; fruit pedicels more than 1.5 cm. long. Himalayas of Tibet to China. . . . . *Coriaria terminalis*

b. Stems woody, perennial; leaves of the flowering axes lanceolate to elliptic, with 3 to 5 main basal veins; fruit pedicels less than 1 cm. long. . . . . *Coriaria ruscifolia*

c. Suffruticose herbs to large shrubs; main axes bearing numerous short branches bearing inflorescences terminally; leaves 0.5 to 3.1 cm. long. Western slopes of the Andes from Mexico to Peru, and cool mountains of New Guinea and New Zealand. . . . . *Coriaria ruscifolia* subsp. *microphylla*

c. Large shrubs to small trees; main axes bearing inflorescences in the axils of the leaves or rarely on short branches; leaves 1.0 to 7.5 cm. long. Temperate coasts of Chile, New Zealand and

other Pacific islands. .... *Coriaria ruscifolia* subsp. *ruscifolia*

a. Bases of lateral branches surrounded by persistent bud scales; inflorescences produced from the axils of the leaves of the previous flush of growth; bracts subtending the flowers ovate to orbiculate; flowers usually andromonoecious; inner whorl of stamens epipetalous. Shrubs of the Northern Hemisphere. (d)
   - d. Racemes finely puberulent to densely pubescent; achenes 1.5 to 2.5 mm. long; bracts subtending the flowers subentire to erose. Northern India, Nepal and Western China. .... *Coriaria nepalensis*
   - d. Racemes glabrous; achenes more than 3 mm. long; bracts subtending the flowers entire. (e)
     - e. Accrescent petals far exceeding the mature achenes and enclosing them; leaves ovate-lanceolate; styles linear to fusiform. Japan, Formosa and the Philippines. .... *Coriaria japonica*
     - e. Accrescent petals not exceeding the exposed mature achenes; leaves subelliptic; styles filiform. West-Mediterranean region. .... *Coriaria myrtifolia*

Coriaria ruscifolia L., Species Plantarum, ed. 1. 1037. 1753.

Plants fruticose; new branches sprouting and developing rapidly, fleshy, at first terete, green to purple to gray, secondary growth producing a quadrangular stem which is brown or gray at maturity, cork developing early, lenticels present only on the previous flush of growth, scaly terminal buds not formed.

Leaves subsessile, glabrous and dark green above, puberulent on the emersed veins and paler beneath; leaves of the main stem orbiculate, with 5 to 9 main basal veins, those of the lateral branches elliptic to lanceolate, with 3 to 5 main basal veins, acute to cordate at the base, the apex acute to mucronate.

Racemes few to numerous, pendent, finely to densely pubescent, the pedicels ebracteolate, 3 to 6 mm. long, at

maturity less than 1 cm. long, with entire, lanceolate to subulate bracts. Flowers 2 to 3 mm. in diameter, usually pentamerous, regular, perfect, proterogynous, sepals ovate, green to red, 1.5 to 2 mm. long, 1 to 1.5 mm. wide, petals smaller, ovate, anthers yellow to reddish, styles linear, fasciculate, green to purple, matured achenes enclosed by the accrescent fleshy, black petals, 1 to 2.5 mm. long.

The numerous populations of *Coriaria* found in the Western Hemisphere are here regarded as two subspecies of a single species, polymorphic in leaf size and shape and habit in response to geographic location and altitude. The characters which unite all these plants into one species are listed below:

1. The inflorescences are produced on wood of the current growing season. These racemes are either borne terminally on the lateral leafy branches or from the axils of the large orbiculate leaves on the main axes.

2. The leaves on the lateral branches have 3 to 5 veins.

3. The flowers have the same morphology throughout the distributional range and are always perfect, a trait shared only with *Coriaria terminalis* of the Himalayas.

The two subspecies have heretofore been maintained as separate species since they were first described. Reducing these taxa from species to subspecies reflects their similarity and at the same time illustrates the differences in morphology which are ecological adaptations to altitudinal changes. At higher elevations, 600 m. to 4000 m. in the Andes, small-leaved forms occur while larger-leaved forms grow at elevations from sea level to 300 m. in southern South America. Another character which varies with altitude and which is noticeable in dried specimens as well as in the living plants is the increased numbers of lateral branches occurring with increased elevation. The correlation with altitude of these variations, independent of genetic constitution, has been demonstrated by comparisons of seedlings of South American forms grown under identical greenhouse conditions at the University of Connecticut. Seeds were collected in Colombia at 3200 m. (*Skog* 1000)

and Chile at 5 m. (*Skog* 1075), germinated and grown together in the greenhouse. The resulting plants were similar in leaf size and shape, and bore few lateral branches. (Herbarium vouchers are on file at CONN of the representative plants, *Skog* 1375, 1376.) Studies of herbarium specimens and field observations indicate that when plants otherwise assignable to the small-leaved subspecies, *C. ruscifolia* subsp. *microphylla*, are found at lower elevation (less than 1000 m.) the leaves are larger and the individuals have fewer lateral brances.

Coriaria ruscifolia L. subsp. *ruscifolia*

Coriaria ruscifolia L., Species Plantarum, ed. 1. 1037. 1753. Type: Feuillée, Journal des observations physiques, mathématiques et botaniques 3 [Histoire des plantes médecinales . . . du Perou & du Chily]: 17, t. 12. 1725?

Large shrubs to small trees. Main axes to 7 m. long, bearing whorled or opposite leaves 1.0 to 7.5 cm. long, 0.8 to 3.2 cm. wide. Racemes arising from the axils of the leaves of the main axes, or at the apices of the few lateral branches, to 25 cm. long.

Vernacular names: CHILE: deu, dehue-lahuen, deó, hiuque, mataratones, veu.

Distribution and habitat in the Western Hemisphere: River banks or lake shores in western Argentina in the province of Neuquén, and in central and southern Chile in the provinces of Arauco, Biobio, Cautin, Chiloé, Concepción, Llanquihue, Malleco, Maule, Ñuble, Osorno, Santiago and Valdivia.

Representative specimens examined: **ARGENTINA.** PROVINCE OF NEUQUÉN: Lago Nahuel Huapi, Isla Victoria, *Cordini* 8 (F, US). **CHILE.** PROVINCE OF ARAUCO: Contulmo, *Gunckel* 21784 (CSG); *Santa Cruz* s. n., I.835 (BH). PROVINCE OF BIOBIO: Fundo 'Los Prados,' *Riegel* s. n., Jan. 1, 1955 (CSG). PROVINCE OF CAUTIN: Rio Quepa, Temuco, *D. Bullock* s. n., 31 Jan. 1906 (BM); Quebrada del Río Palquin, *Gunckel* 15413 (CSG); Puerto Saavedra, *Hollenmayer* 8 (CSG, M). PROVINCE OF CHILOÉ: Chiloé, *J. Anderson* 61 (BM); Piruquina, *Junge* s. n., Mar. 25, 1932 (CSG); *Junge* 386 (M, MO); near Puerto Varas, 50 m., *Morrison* 17537 (BH, GH, MO); Castro, 1-10 m., *Pennell*

12600 (F, GH, SGO, US); cerros cerca de Chonchi, *Ricardi* 5308 (CONC, CONN). PROVINCE OF CONCEPCION: Laraquete, *Castillo* s. n., Feb. 1946 (CSG); Conception, *Cuming* 1461 (BM); Tomé, *Germain* s. n., Nov. 1855 (GH, SGO); Talcahuano, *Pöppig* 131 (BM, MO); near Tumbes, 5 m., *Skog* 1040 (CONN). PROVINCE OF LLANQUIHUE: Lago Llanquihue, *Calvert* s. n. in 1912 (BM); Petrohue, *Gunckel* 9227 (CSG); Piedra Azul, *Ricardi* 5286 (CONC, CONN); Casa Panque, *Shannon & Shannon* 24 (US); near Los Riscos, 200 m., *Skog* 1073, 1074, 1075 (CONN); near Ensenada, 100 m., *West* 4678 (GH, MO). PROVINCE OF MALLECO: Puren, *Claude-Joseph* 3029 (US). PROVINCE OF MAULE: Constitución: *Burnier* s. n., Sept. 1958 (CSG), *Gunckel* 21785 (CSG), *Volckmann* s. n. (SGO). PROVINCE OF ÑUBLE: Valle Rio Renegado: *Alvares Ramirez* s. n., Mar. 1954 (CSG), *Cuming* 146 (E, GH); Valle de Alico, *Jarpa* s. n., Feb. 10, 1935 (CSG); *Reed* s. n., 1871 (BM, GH); *Sargent* s. n., Jun. 29, 1906 (A). PROVINCE OF OSORNO: Fundo Río Blanco, southwest of Purranque, *Eyerdam* 10758 (F, US); Lago Llanquihue, *F. Phillipi & Barchers* s. n., 15/1/85 (BM); north shore of Lago Llanquihue, *Senn* 4635 (MO, US); southwest of Puerto Klocker, near Lago Llanquihue at base of Volcán Osorno, *Skog* 1062, 1064 (CONN). PROVINCE OF SANTIAGO: Claude-Joseph 957 (GH, US). PROVINCE OF VALDIVIA: Valdivia, *Bridges* 612 (BM); Uferbüsch des Calle-calle, *Buchtien* s. n., Sept. 17, 1896 (E, GH, M, US); ad margines rivulorum, *Gay* 1019 (SGO); Isla del Ray, Carbonares, *Gunckel* 1097, 1149 (CSG); Valdivia, *Buchtien* s. n., 12.XI.1904 (LD); Valdivia, *Lechler* s. n. (M).

Coriaria ruscifolia L. subsp. *microphylla* (Poir.) L. Skog *stat. nov.*

Coriaria microphylla Poir., Encyclopédie méthodique. Botanique 4: 87. 1804. Type: *J. Jussieu* s. n., P-JU.

Coriaria thymifolia Humb. & Bonpl. *ex* Willd., Species Plantarum, ed. 4. 4: 819. 1805. Type: *Humboldt & Bonpland* 3018, B, P.

Coriaria phylicifolia Humb. & Bonpl. *ex* Willd., Species Plantarum, ed. 4. 4: 819. 1805, *ex char.*

Coriaria atropurpurea DC., Prodromus systematis naturalis regni vegetabilis 1: 740. 1824. Type: De Candolle, Calques des dessins de la flore du Mexique de Moçiño et Sessé, t. 1167.

Heterocladus caracasanus Turcz., Bull. Soc. Imp. Naturalistes Moscou **20:** 152. 1847. Type: *Galeotti* 293, LE.

Heterophylleia caracasana (Turcz.) Turcz., Bull. Soc. Imp. Naturalistes Moscou **21:** 591.

Coriaria cuneifolia Sessé & Moc., Plantae Novae Hispaniae, ed. 1. 173. 1890, *ex char.*

Suffruticose herbs to large shrubs. Main axes to 4 m. long bearing numerous short lateral branches. Leaves opposite to approximate, 0.5 to 3.1 cm. long, 0.2 to 1.6 cm. wide. Racemes terminating the lateral branches, to 15 cm. long.

Vernacular names: COLOMBIA: rebentadera. ECUADOR: piñán, shanshi, shanchi or zhanzhi, tinta. GUATEMALA: moco tinto, moco de chompipe. MEXICO: helecho de tierra, tlalocopetate, tlalocopatlatl. PERU: mio-mio, saca-saca, mio-venenosa, raqui-raqui. VENEZUELA: tisís, helecho de playa, helecho-uvite.

Distribution and habitat in the Western Hemisphere: Moist montane forest openings and hillsides in Mexico, Guatemala and Panama and on the western slopes of the Andes in Colombia, Venezuela, Ecuador and Peru.

The plants referred to this subspecies have long been named *C. thymifolia* Humb. & Bonpl. *ex* Willd. *Coriaria microphylla* Poir. predates *C. thymifolia* by almost two years, however, and should be used if this group is maintained as a separate species.

Representative specimens examined: COLOMBIA. ANTIOQUIA: La Sierra, 18 km. north of Medellín, 2000 m., *Archer* 1307 (BM, COL, US). BOGOTÁ: *Holton* 27, 808 (GH); *Triana* 5596 (BM, COL); Cordillera de Bogotá, 2650 m., *Triana* s. n. (BM, MEXU). BOYACA: *Grubb, Curry & Fernández-P.* 519 (COL, US). CALDAS: *Killip & Hazen* 8956 (GH, US); Laguneta, Salento, 2500 m., *von Sneidern* 3149 (COL, MO). CAUCA: Cordillera Central, vertiente occidental, 2470 m., *Cuatrecasas* 19369 (A, 2 sheets, F); Puracé, *Fernández-P.* 6218A (COL); entre Popayán y Puracé, 2500 m., *Yepes Agredo* 390 (COL, F, US). CUNDINAMARCA: Salto de Tequendama, 2100 m., *Alston* 7409 (BM); *García-Barriga* 130, 17488 (COL); al sur de Usme, entre La Regadera y El Hato, 3000-3100 m., *Idrobo, Jaramillo, Mesa-Bernal & Smith* 399 (COL, MO, US). HUILA: Cordillera oriental, east of Neiva, 1300-1800 m., *Rusby & Pennell* 1008 (GH, MO, US). MAGDALENA: *Van der Hammen* 1165 (COL). NARIÑO: *Fernández-P., et al.* 1083 (COL); Pasto, Cebadal, 2700-2800 m., *Schultes & Villarreal* 7939 (COL, F, US). NORTE DE SANTANDER: *Cuatrecasas & García-Barriga* 10064 (COL, US). PUTOMAYO: *García-Barriga* 7766 (COL, US); Valley of Sibundoy,

Sibundoy, 2225-2300 m., *Schultes & Villarreal* 7714 (COL, F). SANTANDER: *Killip & Smith* 16784, 19227 (A, GH, US). TOLIMA: *Cuatrecasas* 9361 (COL, US). VALLE: Cordillera Central, vertiente occidental, 2270-2320 m., *Cuatrecasas* 18140 (F). **COSTA RICA.** CARTAGO: Volcán Irazú: 10000-11300 ft., *Allen* 676 (F, MO); *Fournier* 1202 (CRU); Potrero Cerrado road, 6500 ft., *Lankester* s. n., 1925 (F, US); 2400 m., *Skog* 1339 (CONN); *Smith* 4761 (GH, US, 2 sheets); 1400 m., *Torres-R.* 288, s. n., 1924 (SU). **ECUADOR.** AZUAY: Río Tarqui, 8300 ft., *Camp* E-3905 (F, GH, US). BOLIVAR: entre Guaranda y Vinchoa, 2800 m., *Acosta Solís* 5927 (F). CAÑAR: near the village of Marcos, *Camp* E-2488 (MO). CHIMBORAZO: 2450 m., *Acosta Solís* 5534 (F); Huigra, *Rose & Rose* 22182 (BM, US). IMBABURA: Shanchipamba, 2750 m., *Acosta Solís* 14514 (F, 2 sheets). LOJA: 2200 m., *Dodson & Thein* 567 (MO); near Loja, between 2300-2700 m., *Skog* 1162, 1167, 1168, 1169, 1172, 1192 (CONN). PINCHINCHA: Cord. occ., los Alpes, 2800-3000 m., *Acosta Solís* 7079 (F); vicinity of Quito, 3000 m., *Asplund* 6157 (LD, US); above Quito, 10300 ft., *Balls* B5846 (BM, E, MO, US); Quito, *Couthouy* s. n., 1855 (GH); Quito, *Jameson* 206 (BM); Alrededores de Quito, 2850 m., *Paredes* 23 (Q). TUNGURAHUA: entre Leito y la Coma, Cord. oriental, 2700-3000 m., *Acosta Solís* 8977 (F); Volcano Tungurahua, 2200-2400 m., *Dodson & Thein* 1886 (MO); Rio Ambato Valley, W. of Ambato, *Fagerlind & Wiborn* 965 (LD). LOCALITY NOT DEFINITE: *Heinricks* 634 (M); interandine highland, 2000 m., *Rimbach* 97, (A, F). **GUATEMALA.** CHIMALTENANGO: Barranco de La Sierra, southeast of Patzúm, about 2100 m., *Standley* 61508 (A, F). EL PROGRESSO: slopes adjacent to Finca Piamonte, 2500-3000 m., *Steyermark* 43711 (A, F). ESQUINTLA: Texcuaco, 150(?) m., *Morales* 1061 (F). GUATEMALA: near Finca La Aurora, 1500 m., *Aguilar* 248 (F); near Guatemala, *Kellerman* 5252 (MEXU, US); Pinula, 4200 ft., *J. Donnell Smith* 1928 (M). HUEHUETENANGO: San Juan Atitan, 8400 ft., *Skutch* 1166 (A, F). JALAPA: between Miramundo and summit of Montaña Miramundo 2000-2500 m., *Steyermark* 32753 (F). QUEZALTENANGO: Sunil, *Hartweg* 524 (BM, GH, LD); near Santa Maria de Jesus, 6400 ft., *Skutch* 901 (A, F, US). SACATEPEQUEZ: Near Antigua, 6000 ft., *Kellerman* 7510 (F, 2 sheets, US); near San Lucas, 2300 m., *Williams & Molina* 11833 (F, GH). SAN MARCOS: southwest of San Marcos, 8000 ft., *Morley* 725 (F, GH, US). SOLOLÁ: Volcán Atitlán, *Beaman* 4091 (GH); Volcán Santa Clara, 2100-3000 m., *Steyermark* 46991 (F). JUNCTION OF HUEHUETENANGO, TOTONICAPÁN AND QUEZALTENANGO: Sierra Madre mountains, 2400-2600 m., *Williams, Molina & Williams* 22608 (F). LOCALITY NOT DEFINITE: *Fosberg* 19055 (COL, US). **MEXICO.** CHIAPAS: Puerto Viento, Rayón, *Breedlove* 9003 (BM); Mt. Pasitar, near San Cristobal, *Matuda* 461 (F, MEXU, MO, US); Mt. Tacana, 1000-2000 m., *Matuda* 2417 (A, F, MEXU); near San Cristobal de las

Casas, above 7000 ft., *Pfeifer, Kremer & Abendroth* 2501 (CONN, 2 sheets); Rio Prospero, *Seler* 2269 (GH, US). GUERRERO: *Hinton* 14201, 15398 (GH, US); Distrito Mina, Petlacala, *Ynes Mexia* 8972 (F, GH, MO). JALISCO: Rich canyons, mountains near Lake Chapala, *Pringle* 2437 (BM, F, GH, M, MEXU, MO, US). MEXICO: ravines near Ozumba, 8000 ft., *Pringle* 9713 (CU, F, GH, MEXU, MO, US); *Pringle* 11971 (CU, F, GH, US); along brooks, Amecameca, *Purpus* 1768 (F, GH, MO, US); Ozumba, *Purpus* 3057 (BM, E, F, GH, MO, US). MICHOACAN: San Juan Viejo, *Beaman* 4393 (GH); near Paracutín, along road into Angahuan, 7500 ft., *Bratz* M-806 (MEXU); Tancitaro, Uruapan, *Hinton* 15448 (GH, US); 2 km. N. & NE. of Puentacillar, *Iltis, Koeppen & Iltis* 387 (BM); above Tancitaro, 7000 ft., *Leavenworth* 270 (F, GH, MO). MORELOS: Jojutla a de Juárez, D. de Juárez, *Salazar* s. n., August 8 1912 (MEXU, 2 sheets). SINALOA: Along Mex. #40, between Durango and Mazatlan, steep mountain sides, *Pfeifer & Skog* 3073 (CONN). **PANAMA.** Volcán de Chiriqui Potrero Muleto, Boquete district, 10400 ft., *Davidson* 1013 (A, F, US); between El Hato and Cerro Punta, Llanos, *Ebinger* 800 (MO); Petrero Muleto to summit de Chiriqui, *Woodson & Schery* 416 (GH, US). **PERU.** APURIMAC: Prov. Abancay, arriba Abancay, 3300-3500 m., *Ferreyra* 9801 (USM); Abancay, *Vargas* 1954 (CUZ); between Huancarama and Cochacaya, 3400 m., *West* 3761 (GH, MO). AYACUCHO: Aina, between Huanta and Río Apurimac, 750-1000 m., *Killip & Smith* 23119 (F, US). CUZCO: Machu-Picchu, 7600 ft., *Gourlay* 87 (E); Machu-Picchu, 2200 m., *Skog* 1144, 1146, 1147 (CONN); Machu-Picchu, 6000 ft., *Stafford* 1053 (BM, F); Urubamba, 2000 m., *Vargas* 1871 (CUZ, GH); Pillahuata, cerro de cusilluyoc, 3000-3300 m., *Pennell* 14131 (F, GH, US); Prov. Quispicanchis, Dist. Marcapata, 3000 m., *Vargas* 9701 (A, F, MO); Ollantaytambo, about 3000 m., *Cook & Gilbert* 607 (A, F, GH, US, 2 sheets). HUANCAVELICA: east of Surcubamba, Prov. Tayacaja, 2500 m., *Stork & Horton* 10343 (A, F, MO). HUANUCO: Prov. Ambo, cerca a San Rafael, 2600 m., *Ferreyra* 1961 (USM, US); Pampayacu to Huanuco, *Kanehira* 230 (A, F); Chaglia, *Woytkowski* 5293 (F, MO). JUNIN: east of Huasahuasi, 2400-2500 m., *Hutchinson* 1115 (BH, F, GH, M, MO, US, USM). LA LIBERTAD: Prov. Otuzco, cerca a Usquil, 3000-3100 m., *Ferreyra* 7668 (US, USM). PUNO: Prov. Carabaya, Ollachea, 2700 m., *Vargas* 6918 (CUZ). LOCALITY NOT DEFINITE: *Jameson* 577 (E); "Perou," *J. Jussieu* s. n. (P-JU); *Ruiz & Pavon* s. n. (BM, MO). **VENEZUELA.** MÉRIDA: Mérida, *Alston* 6673 (BM, US); Plaza de Mucuqui, 2200 m., *Bernardi* 189 (MER, VEN); northeast of Mérida along road to Valencia, 1850 m., *Breteler* 3300 (CONN, IFLA, 3 sheets, US); San Rafael, 3185 m., *Gehriger* 9 (A, GH, MO, US); Distrito Campo Elías, San José de Acequias, 2400 m., *López-Palacios* 774 (CONN, MER); El Cucharito near Tabay Village, 1800 m., *Skog* 1247 (CONN); between Tabay and

Mérida, along Río Chama, 1820 m., *Steyermark* 55865 (F). TÁCHIRA: Distrito Uribante, San José, antes de la poblacion de Pregonero, 1440 m., *Marcano-Berti* 1680 (CONN, MER). TRUJILLO: Jajó, *Burkart* 16686 (VEN).

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LIST OF THE CLADONIAE OF SOUTHEASTERN MASSACHUSETTS, WITH SPECIAL REFERENCE TO THE COLLECTION OF CHARLES ALBERT ROBBINS

LAWRENCE B. MISH

After Charles Albert Robbins died in 1930, S. F. Blake (1933) wrote of the long and methodical collecting and identifying done by this quiet man from Wareham, Massachusetts, compiling the largest private collection of the genus Cladonia up to that time. Robbins' collection for the small town on Cape Cod was more extensive than the collection of Evans (1930) for the whole state of Connecticut. For almost forty years, Robbins' Cladonias have been housed in the Farlow Herbarium and his approximately 46 species are unknown to the world except for those discussed in his five papers, published between 1924 and 1929.

While surveying the plants of Southeastern Massachusetts during a sabbatical leave in 1968-69, it was found that some of the plants in the Robbins collection were not included in the work of Thomson (1967). It would seem wise, therefore, to publish a list at this time. The numbers appearing in front of each taxon correspond to those of Thomson (1967). Where no connection could be made with the taxa in Thomson's work, Zahlbruckner (1922-1940) was referred to. The letters following the taxa indicate the collection locality, *viz.*:

B	— Bournedale	NF	— North Falmouth
Br	— Bridgewater	O	— Orleans
Bre	— Brewster	P	— Plymouth
C	— Carver	R	— Rockland
D	— Duxbury	S	— Stoughton
E	— Eastham	Sh	— Sharon
H	— Hingham	W	— Wareham
M	— Marshfield	Wf	— Wellfleet
Na	— Nantucket	WH	— Woods Hole

Those citations marked with an asterisk (*) are for plants not collected by Mr. Robbins.

SCIENTIFIC NAME	PLACE
1. *C. papillaria* (Ehrh.) Hoffm.	B
f. *molariformis* (Hoffm.) Schaer.	W, S
f. *papillaria* Thoms.	W
f. *stipata* Flk.	W, S
5. *C. coccifera* (L.) Willd.	*H
v. *frondescens* (Nyl.) Vain.	W
v. *stemmatina* Ach.	W
9. *C. deformis* (L.) Hoffm.	
f. *crenulata* Ach.	W
11. *C. pleurota* (Flk.) Schaer.	W, S, C
12. *C. incrassata* Flk.	W
f. *clavata* Robb.	W
f. *squamulosa* (Robb.) Evans	W
14. *C. floerkeana* (Fr.) Flk.	W
v. *intermedia* Hepp.	
f. *fastigiata* Laur.	W
v. *intermedia*	
f. *peritheta* Robb.	W
f. *intermedia* (Hepp.) Thoms.	W
f. *carcata* (Ach.) Thoms.	W
f. *floerkeana* Thoms.	W
f. *squamosissima* T. Fr.	W
15. *C. bacillaris* (Ach.) Nyl.	W, S
f. *attenuata* Robb.	W
f. *peritheta* (Wallr.) Zahlbr.	W
f. *fruticaulescens* Vain.	W, B
f. *obtusa* Wallr.	W
f. *bacillaris* Thoms.	W, S
16. *C. cristatella* Tuck.	Widespread
f. *aurantiaca* Robb.	W

	f. *lepidifera* (Vain.) Robb.	W
	f. *pleurocarpa* Robb.	W, C
	f. *squamulosa* Robb.	W, C
	f. *squamosissima* Robb.	S
	f. *cristatella* Thoms.	W, B, S, Wf
	f. *ochrocarpa* Tuck.	W, C
	f. *ramosa* Tuck.	B
	f. *vestita* Tuck.	W, C, S
21.	*C. macilenta* Hoffm.	W
	f. *macilenta* Thoms.	W, M, C
22.	*C. didyma* (Fée) Vain.	
	var. *muscigena* (Eschw.) Vain.	W
23.	*C. leporina* Fr.	*Na
25.	*C. piedmontensis* Merr.	W, C
	f. *lepidifera* (Vain.) Robb.	W, C
	f. *phyllocoma* Robb.	C
	f. *obconica* Robb.	C
	f. *piedmontensis* Thoms.	C
	f. *intermedia* Robb.	C
	f. *squamossisima* Robb.	C
30.	*C. strepsilis* (Ach.) Vain.	S
	f. *abortiva* Robb.	W
	f. *strepsilis* Thoms.	W, S
	f. *coralloidea* (Ach.) Vain.	W, S
	f. *glabrata* Vain.	W, S
31.	*C. robbinsii* Evans	
	f. *squamulosa* (Evans) Evans	W, S
32.	*C. capitata* (Michx.) Spreng.	W
	f. *capitata* Thoms.	W
36.	*C. clavulifera* Vain.	W, S, C, B
37.	*C. apodocarpa* Robb.	W
39.	*C. polycarpoides* Nyl.	W, S
	f. *epiphylla* (Robb.) Thoms.	W

f. *squamulosa..*(Robb.) Thoms.	W
f. *polycarpoides* Thoms.	C
40. *C. cariosa* (Ach.) Spreng.	*Br
f. *squamulosa* (Müll. Arg.) Vain.	W
46. *C. mateocyatha* Robb.	W
f. *squamulata* Robb.	W
47. *C. gracilis* (L.) Willd.	
var. *dilitata* (Hoffm.) Vain.	W
f. *dilacerata* (Flk.) Vain.	W
var. elongata (Jacq.) Fr. f. *elongata* Thoms.	W
49. *C. verticillata* (Hoffm.) Schaer.	W
f. *pallida* Robb.	W
var. *cervicornus* Flk.	
f. *phyllophora* Flk.	W
f. *phyllocephala* Flot.	W, C
f. *aggregata* (Del.) Oliv.	*M
f. *apoticta* (Ach.) Vain.	W, C
f. *phyllocephala* (Flot.) Oliv.	W
f. *verticillata* Thoms.	B
56. *C. simulata* Robb.	W
57. *C. pityrea* Flk.) Fr.	
var. *pityrea* Thoms.	W
f. *pityrea* Thoms.	W
f. *squamulifera* Vain.	W
f. *subacuta* Vain.	W
f. *cladomorpha* (Flk.) Vain.	W
f. *scyphifera* (Del.) Vain.	W
58. *C. pyxidata* (L.) Hoffm.	Widespread
var. *pyxidata* Thoms.	W, D
f. *centralis* Oliv.	W
f. *marginalis* Hoffm.	W
f. *prolifera* Wallr.	W

f. *lophyra* (Ach.) Körb.	W
f. *homodactyla* Wallr.	W
59. *C. chlorophaea* (Flk.) Spreng.	W
f. *costata* (Flk.) Arn.	W
f. *simplex* (Hoffm.) Arn.	W
f. *prolifera* (Wallr.) Arn.	W, C
60. *C. grayi* Merr.	W, C
f. *peritheta* Evans	W
f. *cyathiformis* Sandst.	W
f. *centralis* Evans	W
f. *prolifera* Sandst.	W, C
f. *squamulosa* Sandst.	W
f. *pallida* Robb.	W
f. *epiphylaa* Robb.	W
f. *foliosa* Robb.	W
f. *clavata* Robb.	W
64. *C. fimbrriata* (L). Fr.	
f. *stenoscypha* Evans	W
f. *conista* (Ach.) Robb.	W, B
f. *pycnotheliza* (Nyl.) Vain.	W
f. *simplex* (Weiss) Vain.	*Br
66. *C. nemoxyna* (Ach.) Nyl.	W, C, S
f. *ambigua* Wallr.	W
f. *phyllocephala* Arn.	W
f. *scyphifera* Robb.	W
f. *nemoxyna* Thoms.	W
68. *C. coniocraea* (Flk.) Spreng.	W
f. *ceratodes* (Flk.) Thoms.	W, S
f. *phyllostrota* (Flk.) Vain.	W
f. *truncata* (Flk.) DT. & Sarnth.	W
f. *actinota* Flk.	W
f. *pycnotheliza* (Nyl.) Vain.	W
f. *peritheta* Robb.	W
72. *C. turgida* (Ehrh.) Hoffm.	*M
f. *conspicua* (Schaer.) Nyl.	*Br

76.	*C. furcata* (Huds.) Schrad.	W, E, D
	var. *furcata* Flk.	W
	f. *fissa* (Flk.) Aigr.	W
	f. *furcata* Thoms.	W
	f. *subclausa* (Sandst.) Evans	W
	f. *rigidula* Mass.	W
	f. *subulata* (Ach.) Vain.	W
	f. *corymbosa* (Ach.) Vain.	W
	var. *palamaea* (Ach.) Vain.	W
	var. *paradoxa* Vain.	W
	var. *pinnata* (Flk.) Vain.	
	f. *recurva* (Hoffm.) Sandst.	W
	f. *foliolosa* (Del.) Vain.	W
	f. *turgida* Scriba ex Sandst.	W
77.	*C. scabriuscula* (Del. in Duby) Nyl.	W
	f. *elegans* Robb.	W
	f. *squamulosa* Robb.	W
	f. *adspersa* Flk.	W
	f. *farinacea* (Vain.) Sandst.	W
	f. *scabriuscula* Thoms.	W
79.	*C. parasitica* (Hoffm.) Hoffm.	W
	f. *congesta* Robb.	W
	f. *sterilia* Robb.	W
	f. *parasitica* Thoms.	W, S
81.	*C. floridana* Vain.	W
82.	*C. beaumontii* (Tuck.) Vain.	W
83.	*C. caespiticia* (Pers.) Flk.	W, H
	f. *epiphylla* (Arn.) Sandst.	W
86.	*C. multiformis* Merr.	W
88.	*C. carassensis* Vain.	W
	f. *subregularis* Vain.	W
	f. *digressa* Vain.	W
	f. *regularis* Vain.	W
	f. *spectabilis* Robb.	W

f. *obliqua* Robb.	
m. *spectabilis* Robb.	W
f. *subregularis* Vain.	
m. *spectabilis* Robb.	W
f. *subirregularis* Robb.	W
89. *C. squamosa* (Scop.) Hoffm.	W, C
f. *pityrea* Arn.	W
f. *fascicularis* (Del.) Nyl.	W
f. *denticollis* (Hoffm.) Vain.	W
f. *squamosa* Thoms.	W
var. *laevicorticata* Sandst.	
f. *degenerascens* Anders.	W
f. *laevicorticata* (Sandst.) Evans	W
f. *carneopallida* Sandst.	W
var. *muricella* (Del.) Vain.	
f. *sarmentosa* (Tayl.) Müll Arg.	W
f. *ventricosa* (Del.) Oliv.	W
var. *phyllocoma* Robb.	W
f. *muricella* Sandst.	*B
f. *pseudocrispata* Sandst.	W
f. *rigida* (Del.) Nyl.	W
f. *subesquamosa* Nyl.	W
f. *subtrachynella* Vain.	W
f. *turfacea* (Arn.) Vain.	W
90. *C. subsquamosa* (Nyl.) Vain.	
f. *subrigida* Robb.	W
f. *luxurians* (Nyl.) Vain.	W
f. *degenerata* Robb.	W
f. *sublevis* Robb.	W
f. *subrigida* Robb.	W
f. *scabrida* Robb.	W
91. *C. crispata* (Ach.) Flot.	
f. *subascypha* Savicz	W
var. *dilacerata* (Schaer.) Malbr.	W

	f. *elegans* (Del.) Vain.	W
	f. *infundibulifera* (Schaer.) Thoms.	W
	var. *divulsa* (Del.) Arn.	W
	f. *crispata* Thoms.	W
	var. *virgata* Ach.	
	f. *kairamoi* Vain.	W
92.	*C. cenotea* (Ach.) Schaer.	*Br, D
	f. *exaltata* Nyl.	W
	f. *cenotea* Thoms.	W
93.	*C. glauca* Flk.	W
97.	*C. uncialis* (L.) Wigg. f. humilior Fr.	W
	f. *turgescans* (Del.) E. Fries	W
	f. *obtusata* (Ach.) Nyl.	W, E
	f. *uncialis* Thoms.	W
	f. *setigera* Anders	S, W
	f. *soraligera* (Robb.) Sandst.	W
	f. *subobtusata* (Coem.) Arn.	W
101.	*C. boryi* Tuck.	W, P, D, WH, E, Bre, Q
	f. *prolifera* Robb.	W
	f. *lacunosa* (Bory) Evans	W, S, D, Sh
102.	*C. caroliniana* Schwein, ex Tuck.	W
107.	*C. alpestris* (L.) Rabh.	W, Br, E, H
108.	*C. impexa* Harm. f. *prolifera* Robb.	W
	f. *impexa* Thoms.	W
	f. *subpellucida* Harm.	W
109.	*C. terrae-novae* Ahti	W
110.	*C. tenuis* (Flk.) Harm.	W, S, R
	f. *prostrata* Robb.	W
	f. *prolifera* Robb.	W
111.	*C. subtenuis* (Abb.) Evans	W, S, E

113.	*C. mitis* Sandst.	W, R, Nonquit
	f. *pallida* Robb.	W
	f. *tenuis* Sandst.	W
	f. *divaricata* Sandst.	W, S
	f. *prolifera* Sandst.	W, NF
	f. *soralifera* Sandst.	W
	f. *prostrata* Sandst.	W, S, NF
115.	*C. sylvatica* (L.) Hoffm.	W, S, Na
	f. *sphagnoides* (Flk.) Oliv.	W, C
	f. *congesta* Robb.	W
	m. *fissa* Flk.	W
	f. *gracilior* Vain.	W
	f. *arbuscula* Wallr.	W
	f. *decumbens* Flk.	W
	f. *scabrida* Robb.	W, S
	m. *sorediata* Sandst.	W
	f. *pygmaea* Sandst.	W
116.	*C. rangiferina* (L.) Wigg.	Widespread
	f. *incrassata* (Schaer.) Anders	W
	f. *tenuior* (Del.) Vain.	W

Not included in Thomson's book:	W
C. poculifera Robb.	W
f. *simplex* Robb.	W
C. pseudopyxidata Robb.	W
f. *clavata* Robb.	W
f. *Simplex* Robb.	W
f. *squamulosa* Robb.	W
f. *lateralis* Robb.	W
f. *prolifera* Robb.	W
C. pyxioides (Wallr.) Britz. f. *simplex* Britz.	W
C. spumosa Flk.	W

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ON THE MARINE ALGAE OF KENT ISLAND, BAY OF FUNDY

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The extreme tidal amplitudes found in the Bay of Fundy are world famous, and biologists are intrigued by the relationship between organisms and altitudes of such extreme tides. Whereas much of the benthic region of the upper reaches of the bay consists of clean-swept mud, there are scattered rock outcrops along the bay where attached algae can be studied. One such spot is Kent Island, New Brunswick, a fairly small island in the mouth of the Bay of Fundy. It lies just southeast of Grand Manan Island and is one of the Three Island group, located at approximately 44°35′ N lat and 66°46′W long.

The junior author (rdw) visited the Bowdoin College Biological Station on Kent Island from June 28 to July 3, 1957, to study the marine algae. The results were compiled, but publication was deferred at the request of a colleague. Now, after nearly a decade during which no apparent conflict of interest was apparent, further delay seemed unjustified; and, at the request of other colleagues, the report is now issued.

During the five days on the island, collecting was done around the entire coastline; but, as work was sharply limited by rains, effort was concentrated in four areas: — on the north shore (N), a boulder-strewn beach; — on the east shore (E), a cobble beach with rocks and tide pools at the low water level; — on the south shore (S), a rocky cliff region; — on the west shore in the Basin (B), a cove exposed as mud flats at extreme low tides. Specimens, both dried and fluid (5% of neutral formalin in seawater), were prepared and are on deposit at the University of Rhode Island. Examination of the specimens and compilation of the data was the primary responsibility of the senior author (klk); while the field work, observations, and final preparation of manuscript were the responsibility of the junior

author (rdw). Classification and nomenclature follow Taylor (1957).

Perhaps the first report of the algae of the island was by Bowers (1942) who identified 35 species, 15 of which were not noted during the present study. Other early reports of algae from the region but not from the island itself are those by Hay (1882) of 33 species and Hay and McKay (1886) for the Bay of Fundy. In addition, there are records by Eaton (1873) for Maine, Klugh (1917) for New Brunswick, Roscoe (1931) for Nova Scotia, Bell and MacFarlane (1933a, b) of 66 species for the Bay of Fundy, Humm (1950) for Newfoundland, and Taylor (1937; 1957) who treated in detail the algae of the entire northeastern coast of North America, including the Bay of Fundy.

The junior writer (rdw) is indebted to Dr. James Moulton of Bowdoin College for the idea and arrangements for the visit; Dr. Charles Huntington, Director of the Bowdoin College Biological Station, and his wife, for their kindness and hospitality; and to that fabulous down east captain who "punched" his way through the impenetrable fog and found Kent Island "by ear."

(E = east shore; B = Basin; N = north shore; S = south shore; see text for descriptions)

Chlorophyceae

Ulotrichaceae

1. *Ulothrix flacca* (Dillw.) Thuret. E, S. Abundantly matted on rocks at + 11 ft.

Ulvaceae

2. *Enteromorpha clathrata* (Roth) J. Ag. — N, E, S, B, N of Basin.
   Variable in habit. Not common.

(2a. *E. compressa* (L.) Grev. — (Bowers, 1942)).

3. *E. erecta* (Lyngb.) J. Ag. — E. Rare.
4. *E. intestinalis* (L.) Link — N, E, S, B, N of Basin. On rocks and stones. Common.
5. *E. linza* (L.) J. Ag. — E. Rare.

(5a. *E. marginata* J. Ag. — (Bowers, 1942)).

6. *E. minima* Näg. — E. Attached to stones.
7. *E. prolifera* (Müll.) J. Ag. — E, B. Masses attached to rocks in lower littoral. (also Bowers, 1942).
8. *Monostroma fuscum* (Post. & Rupr.) Witt. (f. *blytii* (Aresch.) Collins — N. In wash, rare.
9. *Ulva lactuca* L. — N, E, S. Lower littoral. (also Bowers, 1942).

Prasiolaceae

10. *Prasiola stipitata* Suhr — N, E. Found high in spray zone.

Cladophoraceae

11. *Chaetomorpha melagonium* (Web. & Mohr) Kütz. — Found in midlittoral zone and lower tide pools.
(11a. *C. area* (Dilw.) Kütz. — Bowers, 1942).
12. *Cladophora gracilis* (Griff. ex Harv.) Kütz. — N, E, S, B. Abundant throughout mid and lower littoral zone.
13. *C. ruprestris* (L.) Kütz. — N, B. Uncommon, in lower littoral.
14. *C. refracta* (Roth) Kütz. — N, B. Uncommon. (also Bowers, 1942).
15. *Rhizoclonium tortuosum* Kütz. — N. With *Cladophora* sp. in midlittoral tidepools.
16. *Spongomorpha arcta* (Dillw.) Kütz. — E, S. Forming thick, stiff tufts up to 6 in. in diameter, abundant in lower littoral zone.
17. *S. spinescens* Kütz. — S. Uncommon, in association with *S. arcta.* At + 3 ft.

Phaeophyceae

Ectocarpaceae

18. *Ectocarpus confervoides* (Roth) Le Jol. — N, B. Epiphytic on coarser brown algae.
(18a. *Giffordia granulosa* (J. E. Smith Hamel — (Bower, 1942, as *E. granulosus*)).
19. *Pylaiella littoralis* (L.) Kjellm. — B. On rocks, *Fucus* and *Ascophyllum.*

Ralfsiaceae

20. *Ralfsia fungiformis* (Gunn.) Setch. et Gard. — N, E, S. Forming crusts several inches in diameter on rock, upper littoral zone.

Elachisteaceae

21. *Elachistea fucicola* (Vell.) Aresch. — N, E. S. Attached in dense tufts to *Ascophyllum.*

Chordariaceae

22. *Chordaria flagelliformis* (Müll.) C. Ag. — E, B. Found awash, often mixed with *Dumontia.*
23. *Sphaerotrichia divaricata* (C. Ag.) Kylin. — N of Basin. Occasional, + 9 to + 13 feet.

Desmarestiaceae

24. *Desmarestia aculeata* (L.) Lamour. — N, S, B. Occasional, found in lower littoral.
25. *D. viridis* (Müll.) Lamour. — E. On shells of lower littoral, + 4 ft.

Punctariaceae

(25a. *Asperococcus echinatus* (Mert.) Grev. — (Bowers, 1942)).
26. *Scytosiphon lomentaria* (Lyngb.) C. Ag. — S. Attached to rocks, + 2 ft.
27. *Punctaria latifolia* Grev. — E, S, B. Common at or below low water.

Dictyosiphonaceae

28. *Dictyosiphon foeniculaceus* (Huds.) Grev. — E, B. Common near low water.

Laminariaceae

29. *Agarum cribrosum* (Mert.) Bory — N. Occasional, in sublittoral region. (also Bowers, 1942).
30. *Alaria esculenta* (L.) Grev. — E, N, S. Fairly common near or below low water. (also Bowers, 1942).
31. *Laminaria agardhii* Kjellm. — N, E, S. Common, found with *Alaria.* (also Bowers, 1942).

32. *L. digitata* (L.) Lamour. — E, S. Common below low water. (also Bowers, 1942).
(32a. *L. intermedia* Fosl. — (Bowers, 1942)).
33. *L. longicruris* De La Pyl. — B. Found attached to weir. (also Bowers, 1942).
34. *L. platymeris* De La Pyl. — E, B. In tide pools on beach at + 2 ft.
(34a. *L. stenophylla* (Kütz.) J. Ag. — (Bowers, 1942); = *L. digitata* fide Taylor (1957: 185).
35. *L.* sp. —B. A form similar to *L. agardhii* but with flat stipe, 0.5-2 cm. thick; blade thinner and wider.

Fucaceae

36. *Ascophyllum nodosum* (L.) Le Jol. — N, E, S, B. Common in the entire littoral zone in most areas. (also Bowers, 1942).
(36a. *A. mackaii* (Turn.) Holms et Batt. — (Bowers, 1942)).
37. *Fucus edentatus* De La Pyl. — N, E. Form with extremely flattened and broad receptacles. (also Bowers, 1942).
38. *F. evanescens* C. Ag., prox. — S of Basin. Occasional on rocks in sand. (also Bowers, 1942).
39. *F. filiformis* Gmelin — N, E. Common in high tide pools. (also Bowers, 1942).
40. *F. spiralis* L. — N, E, S, B. Common in all areas of the upper littoral zone, often mingling with strand vegetation.
41. *F. vesiculosus* L. — N, E, S. B. Common throughout the littoral zone (also Bowers, 1942).

Rhodophyceae

Bangiaceae

42. *Porphyra umbilicalis* (L.) J. Ag. — E, S. Occasional in lower littoral. (also Bowers, 1942).

Acrochaetiaceae

43. ?*Acrochaetium daviesii* (Dillw.) Näg. — N.
(43a. *Kylinia secundata* (Lyngb.) Papenf. — (Bowers, 1942 as *A. secundatum*)).

Dumontiaceae

44. *Dumontia incrassata* (Müll.) Lamour. — E, S. Attached to rock in tide pools, commonly with *Chordaria.*

Squamariaceae

45. *Hildenbrandia prototypus* Nardo — E. Common in tide pools in the upper littoral.

Corallinaceae

46. *Corallina officinalis* L. — E, S. Abundant at or slightly above low water level.

Kallymeniaceae

47. *Euthora cristata* (L.) J. Ag. — S, W. Found awash.

Rhodophyllidaceae

48. *Cystoclonium purpureum* (Huds.) Batt. — N, S. On rocks at low water, with *Porphyra.* (also Bowers, 1942).

Phyllophoraceae

49. *Ahnfeltia plicata* (Huds.) Fries — E, S. Common in the mid to lower littoral zone.
50. *Phyllophora brodiaei* (Turn.) J. Ag. — E. S. Occasional.

Gigartinaceae

51. *Gigartina stellata* (Stackh.) Batt. — E, S. Common to abundant in the mid to lower littoral.

Rhodymeniaceae

52. *Halosaccion ramentaceum* (L.) J. Ag. — N, S. Occasional.
53. *Rhodymenia palmata* (L.) Grev. — E. Common at low water, often attaining length of 1.5 m. (also Bowers, 1942).

Ceramiaceae

54. *Ceramium rubrum* (Huds.) C. Ag. — S. Uncommon.
55. *Ptilota serrata* Kütz. — S, B. In wash.

Delesseriaceae

56. *Phycodrys rubens* (Huds.) Batt. — N, S, W. Attached in the lower littoral.

Rhodomelaceae

57. *Polysiphonia harveyi* Bailey — N. Uncommon.

58. *P. lanosa* (L.) Tandy — E, S. Epiphytic on *Ascophyllum,* forming dense masses.

59. *P. nigrescens* (Huds.) Grev. — E, S. Forming dense growths on rocks in lower littoral.

60. *P. urceolata* (Lightf.) Grev. — N. Uncommon.

61. *Rhodomela confervoides* (Huds.) Silva — N, S. Attached to rocks at lower water.

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A WHITE-FLOWERED FORM OF IRIS LACUSTRIS FROM ONTARIO. In an open dune hollow within fifty yards of the shoreline north of McNab Point in Bruce County, Ontario, a white-flowered form of the Dwarf Lake Iris, *Iris lacustris* Nutt., was discovered amongst a few hundred blooming plants of the typical form.

It is proposed that this new form be named *Iris lacustris* Nutt. forma *albiflora* Cruise & Catling, forma nova; differt forma typica quad flores albos non caeruleos habet.

Presently known only from the type collection.

Type (Specimen and Color Photograph): Associating with many of the typical form and with *Oryzopsis asperifolia* and *O. pungens,* in moist sand in first dune hollow behind bay north of McNab Point (44° 28′ N., 81° 24′ W.), U. T. M. G. zone *17, 692243,* ca. 2 miles south of Southampton, Saugeen Township, Bruce County, Ontario. 22 May, 1971, *P. M. Catling & S. M. McKay,* (TRT 168074).

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NEOMIRANDEA ALLENII, A NEW EPIPHYTIC COMPOSITE OF THE AMERICAN RAIN FOREST

R. M. King and H. Robinson

Members of the Eupatorian genus *Neomirandea,* ranging from southern Mexico to Eucador, might well be called the Orchids of the Asteraceae. These usually epiphytic plants with rather succulent stems and showy inflorescences have only recently been recognized as a distinct genus (King & Robinson, 1970). Collectors have often commented, sometimes extensively, on the unusual habit of the plants, and Professor B. L. Robinson (1918) in his description of a Colombian species, *N. sciaphila* (B. L. Robinson) R. M. King & H. Robinson, mentioned the horticultural potential of the plant. It is rare that labels do not mention the vining habit, epiphytic nature, or showy reddish-purple flowers. We take occasion here to call attention to some of the interesting problems of this unique group and to describe a fourteenth species from Panama and Colombia.

The ecology of the genus *Neomirandea* presents a particularly important area for future investigation. Most of the species, even some of the largest ones, are referred to as epiphytic. The habit prompted the name *Eupatorium parasiticum* Klatt, and a collection of the type species of the genus, *N. araliaefolia* (Lessing) R. M. King & H. Robinson was described by Skutch, "shrub or small tree with branches 25 ft. long and 6 inches in diameter. Epiphytic on an oak tree, 8 ft. above ground, the roots clasping the trunk in the manner of those of a strangling fig, concrescent where touching each other. A single large root descends along the trunk to the ground. Flowers white, rare. More about this interesting plant in my journal under March 4, 1933." The new species described here is cited by Allen as "fleshy branching epiphytic shrub 1½ meters. In tops of tallest trees." The question remains, what of the few remaining members of this well marked genus not known to be epiphytic? But for their relationship, these species might never be examined properly to see

if their substrate is in any way specialized, possibly old stumps or rotten logs. Experiments with the seeds of these plants are also essential to determine what adaptation they have to their substrate.

Among the Eupatorieae, *Neomirandea* is one of the few genera of particular interest cytologically. The chromosome picture in the Eupatorieae is for the most part rather simple. Most groups show a haploid number of 10 chromosomes or multiples of that number. *Fleischmannia* normally has $n = 10$, and a few species with $n = 4$ (Baker, 1967). A whole related complex of genera which we call Ageratinoid (*Ageratina, Oxylobus,* etc.) shows base numbers of $x = 17$, and $x = 16$. Thus far, two species of *Neomirandea* have been counted, (Turner & King, 1964), *N. angularis* (B. L. Robinson) R. M. King & H. Robinson, $n = 25$ and *N. costaricensis* R. M. King & H. Robinson, $n = 17$ as *Eupatorium* aff. *eximium*. These two counts suggest some cytological complexity in this genus which is in some ways between the Ageratinoid complex and other members of the Eupatorieae.

The new species is represented by two collections which show a range from Central Panama to the foothills of the northern Andes in Colombia. The characters of the species are as follows:

Neomirandea allenii R. M. King & H. Robinson, sp. nov.

Frutex epiphyticus carnosus. Folia opposita majuscula subglabra integra, petiolo perbreve; laminae late ellipticae 7-9 cm. longae, 4-6 cm. latae, apice anguste obtusatae, nervis lateralibus prominulis pinnatis. Involucri squamae ca. 12 subaequilongae late lanceolatae extus parce pubescentes. Flores ca. 10 in capitulo ca. 4.5 mm. longi; corollae anguste infundibulares extus distincte glanduliferae, faucibus intus glabris; styli non nodulosi; achaenae setiferae et glandiferae inferne dense glanduliferae et setiferae; setae pappi scabrae, cellulis apicalibus setarum nonnullarum valde obtusis.

Fleshy branching epiphytic shrubs. Stems terete, minutely pubescent. Leaves opposite, petioled; petioles glabrous

ca. 5 mm. long, blades fleshy, ovate, entire, glabrous on both surfaces, up to 9 cm. long and up to 6 cm. wide, lateral veins prominent. Inflorescence a corymbose panicle. Phyllaries ca. 12, subequal, broadly lanceolate, pubescent, in 2-3 series. Receptacle flat or slightly convex, glabrous. Heads ca. 10 flowered, flowers purple or pink, ca. 4.5 mm. long (excluding style branches) corollas narrowly funnelform, lobes about as long as wide, outer surface of corolla with numerous short stalked glands, cells broadly oblong with straight walls, inner surface of corolla glabrous; anther appendages large, anther collars slender, composed mainly of rectangular to quadrate cells, walls not ornamented. Style base not enlarged, glabrous, stylar appendages not enlarged, mamillose. Achenes prismatic, 4-5 ribbed, with a few short stalked glands and uniseriate multiseptate hairs, glands and hairs numerous at base and apex, carpopodia distinct, cells quadrate, thin walled, pappus of ca. 30 scabrous setae ca. 5 mm. long, some setae with very blunt apical cells.

PANAMA: PROVINCIA DE COCLE: Region north of El Valle de Anton, alt. 1000 meters, August 21, 1946. Fleshy branching epiphytic shrub, 1½ m. In tops of tallest trees. Leaves leathery. Flowers purple, showy. *Paul H. Allen* 3643 (Holotype NY). Additional collection: **COLOMBIA:** ANTIOQUIA: Above Llano Grande, elevation 2000 m. *Earl L. Core* 497 (US).

The new species by its lack of hairs inside the corolla, and by the lack of an enlarged style base proves to be a member of the subgenus *Critoniopsis* related to *N. eximia* (B. L. Robinson) R. M. King & H. Robinson and *N. sciaphila* (B. L. Robinson) R. M. King & H. Robinson. Among the prominent distinctions of *N. allenii* are the larger leaves with prominent secondary veins, the distinct glands on the surface of the corolla, the hairs and glands near the base of the achenes, and the frequent interspersed pappus setae with very blunt apical cells.

ACKNOWLEDGEMENT

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STUDIES IN THE GUTTIFERAE.
III. AN EVALUATION OF SOME PUTATIVE SPONTANEOUS GARDEN HYBRIDS IN HYPERICUM SECT. MYRIANDRA[1]

PRESTON ADAMS

For many years several species of *Hypericum* have been in cultivation at the Arnold Arboretum, Jamaica Plain, Massachusetts. Some of these are woody shrubs of Sect. *Myriandra* native to eastern North America. Around 1909 Alfred Rehder, a long-time member of the staff, discovered in the Arboretum garden plants of *Hypericum* which appeared to him to be intermediate in many characteristics between some of these native American species. He thought that these "atypical" individuals were spontaneous hybrids and, being interested in new and different plants for horticultural purposes, gave them binomials. The specimens which he collected are now in the herbarium of the Arnold Arboretum.

During monographic studies of the woody specimens of *Hypericum* in eastern North America (Adams, 1962), I examined Rehder's specimens. Having observed little evidence of hybridization among these plants in nature, I welcomed the opportunity to study putative examples of spontaneous crossing under garden conditions. The present contribution is an evaluation of the possible hybrid nature of Rehder's specimens.

Hypericum × *Arnoldianum* Rehder, Mitteil. Deutsch. Dendrol. Ges. **19**: 253. 1910 [1911?]. Rehder applied this name to plants which he believed had originated from a cross between *H. lobocarpum* Gattinger and *H. galioides* Lam., with the latter being the maternal parent. During 1910 Rehder made several collections of this putative

[1]Financial support for this study was provided by the Graduate Council Research Fund of DePauw University and the Fernald Fund for Field Study in Systematic Botany at Harvard University, established by the late Mr. F. W. Hunnewell of Wellesley, Mass. I want to thank Dr. Tod F. Stuessy of Ohio State University for helpful comments on the manuscript.

hybrid. These plants persisted in the Arboretum for many years, there being collections made in 1916, 1921, and 1927 in the herbarium of the Arboretum.

Study of Rehder's specimens of *H.* × *Arnoldianum* lend support to his hypothesis of a hybrid origin for these plants. The most convincing evidence is the presence of a very poor seed set in the mature fruits on a collection made by Rehder on October 9, 1910. In each capsule examined nearly all of the ovules had aborted early in their development and only a few well-formed seeds were present in each fruit.

The exact parental origin of *H.* × *Arnoldianum* is problematical. Some substantiation for Rehder's belief that *H. lobocarpum* may have served as one of the parents of this species is provided by analysis of the style numbers. The 5-styled condition is characteristic of the majority of fruits of *H. lobocarpum:* some 79% of 2014 capsules from 23 collections of wild plants had 5 styles (Adams, 1962). While the 5-styled condition was found in only 3% of the 63 capsules of *H.* × *Arnoldianum* examined, about 16% had 4 styles. The 4-styled condition was present in about 19% of the fruits of *H. lobocarpum* examined. In addition, the deeply lobed condition so characteristic of the capsules of *H. lobocarpum* is approached by the partially lobed fruits of *H. Arnoldianum.* It seems reasonable, therefore, to consider *H. lobocarpum* to have participated in the ancestry of *H.* × *Arnoldianum.*

The identity of the maternal parent of *H.* × *Arnoldianum* is less clear. Study of Rehder's specimens of this species does afford support for his hypothesis that *H. galioides* was involved. Evidence against this hypothesis is provided by analysis of style numbers. Of a total of 63 mature fruits of *H.* × *Arnoldianum* examined, 16% possessed 4 styles, 3% had 5 styles, and the remaining 81% were 3-styled. Capsules of the putative maternal parent, *H. galioides,* are almost invariably 3-styled, with 4-styled fruits being seen very rarely.

What might have been the maternal parent of *H.* × *Arnoldianum*? A clue may be provided by the striking

resemblance between specimens of this species and plants of *H. densiflorum* Pursh, especially those obtained from populations of the latter species growing in eastern Tennessee. In both plants the leaves are 10-15 times longer than wide. In addition, the seed size and coat ornamentation of *H.* × *Arnoldianum* compare very well with that present in *H. densiflorum.* Plants of *H. densiflorum* were in cultivation at the time that Rehder described *H.* × *Arnoldianum* and these could well have served as one of the parents of this species. The close resemblance of *H.* × *Arnoldianum* to plants from the eastern Tennessee populations of *H. densiflorum* could be explained by postulating that some of the Arboretum's living collections of the latter species might have been originally obtained from the Tennessee portion of the geographic range of *H. densiflorum.* The available evidence, therefore, suggests that the spontaneous cross that is hypothesized to have produced *H.* × *Arnoldianum* most likely occurred between plants of *H. densiflorum* and *H. lobocarpum.* Rehder's suggestion that *H. galioides* may have been involved may have been due to misidentification of specimens. Such an error is understandable, since several collectors of *Hypericum* in eastern Tennessee, especially during the late 19th and early 20th centuries, identified specimens of *H. densiflorum* as *H. galioides.* However, both Svenson (1940) and Adams (1962) have shown that the latter species is a native of the lower Atlantic and Gulf Coastal plains.

Further support for the hypothesis that *H. lobocarpum* and *H. densiflorum* may have been the parents of *H.* × *Arnoldianum* is provided by chromosome analysis. In plants from the Arnold Arboretum identified as *H.* × *Arnoldianum* (perhaps the same individuals studied by Rehder), Hoar and Haertl (1932) found a gametic number of 9. They reported "no irregularity in chromosome behavior nor morphological sterility of pollen" and concluded that this hybrid "apparently came from compatible parents." Since they did not preserve voucher specimens, their identification cannot now be verified. *If* they did indeed

study the chromosomes of true *H.* × *Arnoldianum,* then the observed chromosome regularity and viable pollen would constitute strong support for the hypothesis that the putative parents were indeed *H. lobocarpum* and *H. densiflorum.* These two species are very closely related. In fact, *H. lobocarpum,* a plant of Arkansas and adjacent portions of surrounding states, has been considered as a variety of *H. densiflorum* (Svenson, 1940), but the geographic ranges of each of these species are not known to overlap, there being at least 80 miles distance between the nearest known populations (Adams, 1962).

Hypericum × *Dawsonianum* Rehder *l. c.* The plants of this putative hybrid were hypothesized by Rehder to have orginated from a spontaneous cross between *H. lobocarpum* Gattinger and *H. prolificum* L., with the latter as the maternal parent. Two collections, both in mature fruit, were made by Rehder in the Arboretum gardens during the fall of 1910.

That Rehder's plants of *H.* × *Dawsonianum* are most likely indeed of hybrid origin is strongly suggested by the very poor seed set in the fruits, with most of the ovules having failed to develop to maturity. Additional support for this hypothesis is provided by an array of features and conditions more or less intermediate between the two putative parents, *H. lobocarpum* and *H. prolificum.* The seed size and coat ornamentation of the few seeds that are present in the mature fruits are distinctly intermediate between the two presumed parental species. The style number of Rehder's collection of October 9 of *H.* × *Dawsonianum* is also intermediate between these two species: about 50% are 3-styled and 50% are 4-styled. Almost the same ratio of 3- and 4-styled capsules is present in Rehder's collection of October 10; a very few fruits, however, had 5 styles. The 5-styled condition occurred in about 79% of 2014 capsules from 23 collections (Adams, 1962) of *H. lobocarpum.* Fruits with 3 styles are the rule in *H. prolificum,* with only an occasional capsule having 4 or, very rarely, 5 styles. In addition, the fruit size of *H.* × *Daw-*

sonianum is well within the range of *H. prolificum*. The sulcate to deeply lobed capsules of *H.* × *Dawsonianum*, however, are strikingly similar to those of *H. lobocarpum*.

Further substantiation of the hypothesis of hybridization between *H. lobocarpum* and *H. prolificum* is the observation that interbreeding may occur occasionally between plants of these two species growing in the field. I have seen 3 collections from Ripley Co., Missouri (*Steyermark* 66885, F; *Bush* 282, GH, NY; *Makensie* 395, NY) and one from Howell County (*Steyermark* 40010, F, MO) which I cannot assign definitely to either species. Several factors favor the occurrence of hybridization between these two species. The distributional range of the more southern *H. lobocarpum* overlaps that of the more northern *H. prolificum* in central Arkansas, forming a zone some 3 or 4 counties wide running from the southwestern corner of the state diagonally across to southeastern Missouri (Adams, 1962). Plants of both species flower at the same time, and there is little obvious difference in their habitat requirements. As living specimens of *H. lobocarpum* and *H. prolificum* had been cultivated in the Arnold Arboretum for many years, it seems reasonable to conclude that Rehder's *H.* × *Dawsonianum* specimens did indeed originate as the result of spontaneous crossing between these two species under garden conditions.

The meiotic chromosome behavior of an individual plant of *H.* × *Dawsonianum* was reported by Hoar and Haertl (1932) as displaying no irregularity. Neither did they observe any evidence of pollen sterility. Based on their findings, they concluded that the putative parents of the hybrid were genetically "compatible." As with the case of *H.* × *Arnoldianum*, however, no voucher specimens were preserved and, therefore, it is not now possible to verify the original identification.

Hypericum × *nothum* Rehder, *l. c.*, 254. On October 10, 1910 Rehder collected specimens in the Arboretum which he interpreted to be the product of a cross between *H. kalmianum* L. and *H. densiflorum* Pursh, with the latter as the maternal parent. There is little evidence, however,

to support his hypothesis of hybrid origin of these plants. The few 4- and 5-styled fruits present on the specimens of the putative hybrid are suggestive of *H. kalmianum,* which is typically 5-styled although 4 styles are not infrequently encountered. However, most of the fruits on Rehder's specimens have only 3 styles, a characteristic of *H. densiflorum.* Other close resemblances to *H. densiflorum* include seed shape, size and coat ornamentation, inflorescence form, and fruit shape and size. These features strongly suggest that Rehder's specimens of *H.* × *nothum* are most likely not of hybrid origin. They can be readily assigned to *H. densiflorum.*

Hypericum × *VanFleetii* Hort. ex Rehder, Man. Cult. Trees and Shrubs, ed. 2, 640. 1940. According to Rehder, this binomial refers to a horticultural form believed to be a hybrid between *H. prolificum* and *H. frondosum* Michx. There is no evidence that the several specimens of cultivated plants in the herbarium of the Arnold Arboretum bearing this name are of hybrid origin. Instead, I believe that they are readily referable to *H. prolificum.*

It is doubtful if any of these putative hybrids are still being maintained by horticulturists. There were none present in the gardens of the Arnold Arboretum in 1959. This is not surprising since there are several introduced species of *Hypericum* which make better garden plants, with larger and more showy flowers and other more desirable features. In the living collections at the Kew Gardens in England there are several woody shrubs of *Hypericum* Sect. *Myriandra* originally obtained from eastern North America. According to Dr. N. K. B. Robson of the British Museum of Natural History (personal communication), these plants "do not seem to fit exactly into any of the described species." It is entirely possible, therefore, that when two or more of the woody species are brought into the garden, some hybridization may take place. In nature, however, there appears to be very little interspecific hybridization among the woody members of *Hypericum* Sect. *Myriandra.*

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A NEW SPECIES OF THE ORCHID GENUS HOFFMANNSEGGELLA

H. G. Jones

The genus *Hoffmannseggella* was established by the author (Jones, 1968) to accommodate the species which were formerly assigned to the section *Cyrtolaelia* (Schlechter, 1917) of the genus *Laelia*. In his review of *Laelia* published in 1952, the late Dr. F. C. Hoehne, who probably knew these plants better than anyone else, wrote: "Indubitavelmente, elas se distinguem tanto das que constituem as outras secçoes, que poderiam ser agrupadas como gênero distincto"; and later in the same paper; "Acreditamos, entretanto, que haverá vantagem . . . e razão para separar a secção *Cyrtolaelia* de *Laelia* como gênero distincto."

Apart from *Laelia*, one other generic name has been associated with *Hoffmannseggella cinnabarina* (Batem.) H. G. Jones, which is the generic type of *Hoffmannseggella:* in 1843 Hoffmannsegg had transferred this species to his new genus, *Amalias*. Unfortunately, in the original publication of *Amalias* (1842), Hoffmannsegg had made only one specific combination, and this was based upon *Laelia anceps* Lindl., which is a true species of *Laelia*, not belonging to the section *Cyrtolaelia*. Consequently, since *Amalias anceps* (Lindl.) Hoff. automatically becomes the type-species of *Amalias*, this name must be treated as a generic synonym of *Laelia*, and was not available for use for the species of section *Cyrtolaelia*, when the latter were raised to generic rank.

The genus *Hoffmannseggella* falls naturally into two fairly distinct sections: in the typical section (sect. *Hoffmannseggella*), the pseudobulbs are short and thick — conical, subfusiform or ovoid in shape — and the flower-scapes quite tall, usually much longer than the leaves. In the species of sect. *Pleurothalloides*, however, the pseudobulbs are reduced to slender cylindrical stems; and the flower-scapes are much shorter, about equal to or very

slightly longer than the leaves. This gives the plants a rather distinct resemblance to the genus *Pleurothallis* — hence the sectional name — a resemblance which has been commented upon by Reichenbach (1874) and by Hoehne (1930). In the course of delimiting the species of the latter section for my projected monograph of the genus, I have found it necessary to recognize one new species, which is described and named below.

Hoffmannseggella brevicaulis H. G. Jones, sp. nov.

Species affinis *H. harpophyllae* a qua caulibus multo brevioribus, floribus majoribus labello apice anguste attenuato facile distinguitur. Epiphytica, erecta, circa 24 cm alta; rhizomate valde abbreviato; radicibus albescentibus, filiformibus, flexuosis, glabris; caulibus cylindraceis, unifoliatis, circa 7 cm longis; folio erecto oblongo, coriaceo, apice obtuso vel subacuto, circa 17 cm longo, medio circa 2 cm lato. Racemus erectus vel suberectus, 2-3-florus, quam folio multo brevior; floribus luteis, circa 6.5 cm diametribus: sepalis oblongis, apice acutis, circa 3.5 cm longis, medio circa 9 mm latis; petalis quam sepalia aequimagnis vel paulo brevioribus; labello circa 3 cm longo, medio circa 1.5 cm lato, parte superiore profunde trilobo, carinis 2 paralellis elevatis, acutis; lobis lateralis subovatis, acutis; lobo mediano elongato, anguste attenuato, apice multo acuminato. Columna crassa subcylindrica, circa 1 cm longa, medio circa 4 mm lata; ovario pedicellato glabro, circa 4 cm longo.

Type: Brazil, habitat not recorded — flowered under cultivation in Barbados, Feb. 1967. *Herb Jones.* H(L)/19a.

This taxon has been previously referred to by the author in another paper (Jones 1970). It first came to my attention during the course of examining the specimens of *H. harpophylla* (Rchb.f.) H. G. Jones, preserved in Reichenbach's herbarium (Naturhistorischen Museums, Vienna), when I noticed that two of the sheets included under this name were obviously atypical. These were subsequently found to agree with cultivated specimens from Brazil which

undoubtedly represented an undescribed species, somewhat related to *H. harpophylla,* but easily distinguished by the characters described in the above diagnosis, which may be summarized as follows: —

H. HARPOPHYLLA

1. Plants tall and rather loose; pseudobulbs longer than the leaves.
2. Leaves narrow, tapering to a slender, acute point.
3. Inflorescence numerous, 6-8-flowered.
4. Flowers rich orange-red.
5. Sepals and petals narrow, usually less than 6 mm wide.
6. Front lobe of the labellum broadening outwards from the base, apex obtuse.

H. BREVICAULIS

1. Plants shorter and more compact; pseudobulbs shorter than the leaves.
2. Leaves broader, apex obtuse or subacute.
3. Inflorescence 2-3-flowered.
4. Flowers yellow.
5. Sepals and petals broader, 7-9 mm wide.
6. Front lobe of the labellum very narrow, tapering to a long, slender point.

H. brevicaulis is also related to another quite recently-discovered species, *H. Kautskyi* (Pabst) H. G. Jones (**Hoffmannseggella Kautskyi** (Pabst) H. G. Jones, comb. nov. Basionym: *Laelia Kautskyi* Pabst in Orch. Rev. 78: 321. 1970). The latter species resembles *H. brevicaulis* in the color of the flowers, but the habit, the form of the labellum, and the flowering period are all different. All the species of *Hoffmannseggella* are confined geographically to Brazil.

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CHROMOSOME NUMBER IN LIQUIDAMBAR

Frank S. Santamour, Jr.[1]

The genus *Liquidambar* belongs to the Hamamelidaceae, although most authorities consider this genus so distinct that they place *Liquidambar,* along with some other genera such as *Bucklandia* and *Disanthus,* in the sub-family Liquidambaroideae. Cytologically, all genera of Hamamelidaceae (sub-family Hamamelioideae) reported thus far have a basic chromosome number of $x=12$ (Darlington and Wylie, 1955). *Liquidambar* is the only genus of the sub-family Liquidambaroideae that has been studied cytologically.

Anderson and Sax (1935) studied meiosis in *L. styraciflua* L. growing at the Arnold Arboretum in Jamaica Plain, Massachusetts. They concluded that *L. styraciflua* was a diploid ($2n=30$) with a basic number of $x=15$ chromosomes. They also noted marked meiotic irregularities and high pollen sterility in their material, and ascribed these irregularities to cultivation in an area north of the natural species range.

Pizzolongo (1958) reported that the diploid number of *L. styraciflua* (from shoot apices) and *L. orientalis* L. (from root tips) was $2n=32$, and concluded that the haploid (and basic) number was $n=16$. However, the only countable meiotic figure he found in *L. styraciflua* was an anaphase I, showing groups of 15 and 16 chromosomes. Meiotic irregularities and consequent pollen sterility apparently depended "upon some univalent chromosomes which do not respect the metaphasic congression and cause an unequal chromosome distribution among the pollen grains."

This study was conducted in Italy, where the trees, as in the Anderson and Sax work, were growing outside their native range. Even with the irregular meiotic divisions,

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Figure 1. Meiotic stages in *Liquidambar styraciflua* L.;
(a) Diakinesis with n=16 (540 ×)
(b) Anaphase I with two groups of 16 chromosomes (1200 ×).

however, Pizzolongo did not believe that the species had two biotypes, with $2n$=30 and $2n$=32 chromosomes.

Work with *Liquidambar* in the project on "Cytogenetics, Breeding, and Evaluation of Shade Trees" at the U.S. National Arboretum has stressed interspecific hybridization. We have obtained hybrids between *L. stryaciflua* and both Asiatic species, *L. orientalis* and *L. formosana* Hance. Thus, it was important to determine the number and meiotic behavior of the chromosomes of our parent trees, especially *L. styraciflua*, to decide if detailed cytological analysis of the progenies would be necessary.

In the spring of 1971, inflorescences of *L. styraciflua* were collected from 4 native trees on the grounds of the Arboretum in Washington, D. C. Two of these trees were used as parents in the breeding work. The flowers were fixed in 1:3 acetic-alcohol for 24 hours and stored in 80% ethanol. Meiosis in the pollen-mother-cell was studied using standard aceto-carmine squash techniques. Pollen was collected from the same trees and pollen abortion was determined from a random sample of 200 grains stained with aceto-carmine. Pollen size was based on measurements of 50 sound pollen grains from each tree. Mitosis in root tips of seedlings of *L. styraciflua* × *L. orientalis* and *L. styraciflua* × *L. formosana* parentage was also examined using aceto-carmine squash techniques.

Accurate chromosome counts at first metaphase of meiosis were, as noted by previous authors, impossible to achieve. The chromosomes at this stage are clumped together and no more than 10 distinct bivalents could be observed. Usually one, and frequently two, bivalents were found outside the metaphase grouping and exhibited precocious separation. Pizzolongo attributed the high pollen abortion he observed to this irregular chromosome behavior.

In my material it was not difficult to determine $n=16$ chromosomes at diakinesis or late anaphase I. Many diads were counted with this number in both nuclei. At the 4-nucleate stage (anaphase II), nuclei with $n=16$ chromosomes could also be determined, but in no case could all four nuclei be counted.

The major problem in documentation was obtaining figures in which all the chromosomes were in the same plane for photographic purposes. The picture of diakinesis (Fig. 1a) shows 16 chromosomes, with at least three and perhaps four chromosomes attached to the nucleolus. This configuration explains the multinucleolate microspores noted by Pizzolongo. At anaphase I (Fig. 1b), two groups of 16 chromosomes are shown.

Pollen abortion in the four trees studied ranged from 6% to 20% and averaged 11%. Pollen grain diameter averaged about 39 microns, and did not differ significantly among trees. Although abnormal meiotic behavior may explain the rather high pollen abortion sometimes found in this species, the degree of meiotic irregularities probably depends on individual tree characteristics.

Chromosome counts on root tips of hybrids of *L. styraciflua* with *L. orientalis* and *L. formosana* gave $2n=32$. These facts imply that all three species have the same chromosome number.

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RECENT DISCOVERIES IN THE NEW HAMPSHIRE FLORA

A. R. Hodgdon and Frederic L. Steele[1]

Our field work in New Hampshire during the 1971 season consisted only of a few day-excursions, no real effort having been made to search for unusual plants. However, several discoveries were made of which the following are most significant.

Scirpus robustus Pursh. Saltmarsh at Adams Point, Durham, Strafford County, *A. R. Hodgdon, G. Brooke, J. Wicks,* et al., September 29, 1971 #19145. It is often true that several rare and local species may occur in close proximity. It happens that the halophytic composite *Iva frutescens* var *oraria,* previously reported from Durham (Hodgdon & Krochmal 1950), reaches its northeastern known limit of range, aside from its disjunct occurrence in Nova Scotia, within a stone's throw of the Bulrush. The ample size of the *Scirpus* colony shows that it must have been growing here for a long time. Thus it must have been overlooked by the senior author many times during the past twenty or thirty years, perhaps because attention was directed too much to the *Iva.* The nearest reported stations for *Scirpus robustus* are in Newbury and Cambridge, Massachusetts, making the Durham locality the initial record for New Hampshire and the first north of Massachusetts. It is a conspicuous tall sedge, leafy nearly to the inflorescence, with big ovoid spikelets of rich brown color, the plant in size somewhat resembling the also robust *Scirpus maritimus* var *Fernaldi* which, however, typically has elongated spikelets. In the herbarium of the New England Botanical Club there are specimens from coastal areas of southwestern Maine which have regularly been called *S. maritimus* var *Fernaldi,* but which have ovoid spikelets or otherwise approach *S. robustus* in some characteristics.

[1]Published with the approval of the Director of the New Hampshire Agricultural Experiment Station as Scientific Contribution No. 616.

Presumably the separation of these two taxa is not always an easy matter.

Pycnanthemum Torrei Benth. Southern slope of Jeremy Hill, Pelham, Rockingham County, *A. R. Hodgdon* and *Frederic Steele,* August 4, 1971 #19148. Jeremy Hill lies within a mile or two of the Massachusetts line. The southern slope where we found the *Pycnanthemum* has been known for a long time as a rich collecting area; many species of *Desmodium* and *Lespedeza, Phryma leptostachya* and other plants of interest grow along the road which extends upward on the slope into the woods. Arthur Stanley Pease collected there and his success in finding unusual species so far north led the senior author also to visit the place a number of years ago. It has been known as the northeastern known limit of range for *Desmodium marilandicum* (L.) DC., *Lespedeza virginica* (L.) Britton and *Pycnanthemum incanum* (L.) Michx. while at least ten other species are found on this slope that have not been reported in Maine. On our August visit we explored the rocky slope just above the road a little way into the woods and came upon a clump or two of a big mint with which we were unfamiliar but which we assumed to be a *Pycnanthemum* and which proved to be *P. Torrei.* The calyx-teeth of *P. Torrei* are acuminate and are about 1.5 mm long serving readily to separate it from *P. verticillatum* or *P. virginianum.* In addition the leaves are thin and membranaceous and the heads are few at the tips of somewhat elongated slender branches. The leaves of *P. Torrei* are considerably wider than those of *P. tenuifolium.* This is a somewhat remarkable extension of range all the way from New Haven County, Connecticut where there are two stations for it known in New England. It was collected in New Haven by C. H. Bissell and R. W. Woodward in August 1910 and in Cheshire also in New Haven County by E. B. Harger in August 1929. Specimens from these two localities are present in both the Gray and the New England Botanical Club Herbaria. It seems unlikely that this mint, being scarce even in southern Connecticut, has moved

to Jeremy Hill in recent times. On the other hand, it is surprising that it was overlooked by the botanists who have visited the area unless indeed their attentions were too much diverted by all the other interesting plants.

Lechea tenuifolia Michx. Along cleared trail to fire tower, Jeremy Hill, Pelham, *A. R. Hodgdon* and *Frederic L. Steele* #19146. Our success that August day, in finding a species of *Pycnanthemum* seemingly new to New Hampshire, encouraged the first author to assume that other significant species might also be discovered on Jeremy Hill. It was decided therefore to follow a trail upward to the fire tower. Plants of *Viola pedata* were scattered along the trail and higher up, where the trail widened into a cleared roadway there were plants of *Hypoxis hirsuta* in good flower. A few depauperate plants of the pinweed, *Lechea tenuifolia* were growing nearby. In 1879 Kate Furbish found this species in Wells, York County, Maine. In the Herbarium of the New England Botanical Club one can find this Wells specimen but none from New Hampshire. In the Gray Herbarium however, there are two specimens from New Hampshire both being F. W. Batchelder collections from Pelham, one from the Gumpas District, the other with no precise record of locality. It is likely then that ours is the first record from Jeremy Hill and since Batchelder's more recent collection was made in 1902, a contemporary communication about it may be justified to show that it still is to be found north of the Massachusetts line.

Another pinweed, *Lechea villosa*[1], is found on Jeremy Hill and indeed quite generally in townships close to the Massachusetts line in New Hampshire, Durham being a somewhat isolated outpost for it to the northeast.

[1]It seems preferable to retain the binomial *Lechea villosa* of Elliot which is clearly typified and about which there is no question instead of the vague, poorly defined and dubious *L. mucronata* of Rafinesque who published several other names that might be interpreted as *L. villosa* and who demonstrated in his published study of the genus that he failed to understand the group.

Cyperus Houghtonii Torr. Sandy roadside by pond near Silver Lake, Hollis, Hillsboro County, *A. R. Hodgdon* and *Frederic L. Steele*, August 25, 1971 #19144. This rare species is not new to New Hampshire, having previously been collected in Bath and Hinsdale in the Connecticut Valley. Its distribution in New England is somewhat unusual, however, and therefore deserves comment. We found it growing along with *Cyperus strigosus, Fimbristylis autumnalis, Bulbostylis capillaris* and *Panicum philadelphicum* at the edge of a road near a small pond not far from Silver Lake in Hollis. It was difficult to sort out the depauperate plants of *Cyperus* from the other plants with which it grew, indicating that it may be more common in suitable situations, obscured at times by associated plants, than it now seems. Its New England range includes Winslow (Kennebec Valley), Maine where it was discovered by Ralph Bean on July 22, 1915, Bath and Hinsdale, New Hampshire, Chittenden and Rutland Counties in western Vermont and several scattered localities in Massachusetts, there being no records reported by Seymour (1969) from Connecticut and Rhode Island.

Specimens of the four principal species discussed in this article have been deposited in the herbaria of the University of New Hampshire and the New England Botanical Club.

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SOME ALGAL INVADERS OF THE NORTHWESTERN FRINGES OF THE SARGASSO SEA

William J. Woelkerling

The Sargasso Sea encompasses a wide but not sharply delimited area (biologically speaking) of the North Atlantic Ocean situated roughly between 20 and 40 degrees north latitude and 35 and 75 degrees west longitude (Marmer 1928) and owes its name to the presence of two species of brown algae: *Sargassum fluitans* Boergesen and *S. natans* (L.) J. Meyen. On a recent cruise (during May 1970), the author observed numerous plants of *Ascophyllum nodosum* (L.) LeJolis and *Fucus vesiculosus* L. adrift with *Sargassum* along the northwestern fringes of the Sargasso Sea. The area visited includes the region from 69°24′ west longitude to 69°48′ west longitude and 38°53′ north latitude to 39°11′ north latitude (ca. 375 square miles) and lies roughly 125 miles south of Nantucket Island, 150 miles south of Cape Cod, Massachusetts, 170 miles east-southeast of Montauk Point, Long Island, and 75 miles north of the Gulf Stream.

The occurrence of macroscopic algae within the region appeared to be sporadic; densities as high as one plant per square meter were encountered in some places while at others virtually no weed was observed. Entangled masses of *Aescophyllum* and *Fucus* similar to those reported for *Sargassum* (Winge 1923) were not observed.

Samples taken at several stations with the aid of a long-handled dip net revealed both epiphytized and unepiphytized plants of *Ascophyllum* and *Fucus*. In all, 14 species of algae were collected (Table 1) including 2 Chlorophyta, 10 Phaeophyta, and 2 Rhodophyta. None of the epiphytic species has been recorded from the Sargasso Sea previously although isolated plants of *Ascophyllum* and *Fucus* have been reported (Collins 1917, Collins and Hervey 1917, Winge 1923). Many individuals of *Ascophyllum* and *Fucus*

examined appeared fresh and may still have been growing at the time of collection, but others bore very distended receptacles and showed signs of vegetative decay. Most of the epiphytes appeared somewhat moribund and lighter in color than their mainland counterparts and probably were not actively growing. These observations suggest that at least the epiphytized plants encountered represent detached specimens which have drifted out from the east coast of the United States rather than true pelagic forms.

Both *Ascophyllum* and *Fucus*, however, are reported to propagate vegetatively in the drifting state in European waters (Levring 1940, Oltmanns 1889, Reinke 1892, Sauvageau in Collins and Hervey 1971, p. 78) and further study appears warranted to determine whether reproduction of any sort similarly occurs in the northern Sargasso Sea. The presence of apparently healthy, unepiphytized plants of *Ascophllum* and *Fucus* in the region visited certainly suggests the possibility of vegetative propagation. In fact, Collins and Hervey (1917, p. 79) have concluded (without experimental data) that *Ascophyllum* grows actively and occasionally reproduces sexually in the Sargasso Sea. Until more direct evidence comes to hand, however, it seems best to regard *Ascophyllum, Fucus* and particularly their associated epiphytes as invaders rather than permanent components of the Sargasso Sea flora.

Sincere thanks are due Gordon Volkmann of the Woods Hole Oceanographic Institution for arranging passage on the WHOI research vessel ATLANTIS II. One of the prepared sets of herbarium specimens has been retained by the author while duplicates have been deposited in the Farlow Herbarium of Harvard University and the University of California Herbarium at Berkeley. The work described here was supported by Grant GB-13250 from the National Science Foundation to the Systematics-Ecology Program. SEP Contribution No. 231.

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TABLE 1. Algae Collected Along Northwestern Fringes of Sargasso Sea, May 1970.

SPECIES	REMARKS
Chlorophyta:	
Monostroma pulchrum Farlow	On *Fucus*
Spongomorpha arcta (Dillwyn) Kuetzing	On *Fucus*
Phaeophyta:	
Ascophyllum nodosum (L.) LeJolis	Specimens up to 1.0 m long collected
Chordaria flagelliformis (Müller) C. Ag.	Immature; on *Fucus*
Elachistea lubrica Rupr.	On *Ascophyllum* and *Fucus*

Fucus vesiculosus L.	Specimens up to .5 m long collected
Isthomoplea sphaerophora (Harvey in Hooker) Kjellman	On *Polysiphonia lanosa* in turn on *Ascophyllum*
Punctaria latifolia Grev.	On *Fucus*
Punctaria plantaginea (Roth) Grev.	On *Fucus*
Pylaiella littoralis L. Kjellman	On *Fucus*
Sargassum natans L. J. Meyen	Pelagic
Scytosiphon lomentaria (Lyngbye) C. Ag.	On *Fucus*
Rhodophyta:	
Erythrotrichia carnea (Dillwyn.) J. Ag.	On *Fucus*
Polysiphonia lanosa L. Tandy	On *Ascophyllum*

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INTRASPECIFIC VARIATION IN CHROMOSOMES OF SEDUM IN THE SOUTHWESTERN UNITED STATES

CHARLES H. UHL

Many species of *Sedum* include plants with different chromosome numbers (Uhl, 1961, 1970b). This intraspecific variation in number occurs in two patterns, here designated as established variation and casual variation. Established variation is represented by clear-cut geographical or ecological chromosome races, where any population clearly has a standard chromosome number, but populations in other areas or habitats may differ in the number of chromosomes in their sets (dysploidy) or in their number of chromosome sets (polyploidy). Casual variation is more random and accidental and is represented by individual plants that depart from the locally established chromosome race in ways that usually reflect some cytological instability or irregularity. The commonest examples are trisomy ($2n + 1$) and the presence of a variable number of small, extra, accessory, or "B" chromosomes.

Each established variant in chromosome number has a balanced, more or less stable and true-breeding outfit of chromosomes that has been tested and proved and that occupies a geographical or ecological portion of the range of the species. Most casual variants, on the other hand, have an unstable outfit of chromosomes that does not breed true to its own chromosomal type. Casual variants represent a sort of cytological "noise" or "static", and where

they are common they may sometimes blur or obscure the pattern of established variation. They may originate as segregants from hybrids with related species or between different established variants (chromosome races), or their occurrence may simply indicate that the population has not yet evolved to chromosomal stability. Doubtless each established variant first arose as a casual variant that was successful and eventually stabilized, and this process must still be going on. A relatively high background of casual variation might be expected in species with a significant amount of established variation. On the one hand, this reflects the continuation of the processes (instabilities) that originally led to the chromosome races (established variants), and on the other hand it may result from the occurrence of hybrids where the isolation was not yet complete.

The species of *Sedum* in the southwestern United States offer good examples of both types of chromosomal variation. This paper describes the chromosomes and the distribution of the chromosome races in five of these species: *S. cockerellii* Britton (including *S. griffithsii* Rose), *S. niveum* Davidson, *S. stelliforme* S. Wats., *S. wrightii* A. Gray, and *S. havardii* Rose. Probably all of these species, as well as other related species, occur in adjacent areas of northern Mexico, but material from there has been limited, except for *S. wrightii*. Living plants of these species are easy enough to identify, but many specimens of them are incorrectly identified in herbaria. In particular *S. cockerellii, S. stelliforme* and *S. wrightii* have been confused, and ranges given for these species in some Floras cannot be depended upon.

Most plants were collected in the field but grown in cultivation for a time before study. Counts were made from conventional aceto-carmine squash preparations of pollen mother cells. The photographs are from permanent preparations, all $\times$ 2000. Voucher specimens are in the Wiegand Herbarium or Bailey Hortorium of Cornell University.

Clausen and Uhl (1943) classified *S. cockerellii* and *S. griffithsii,* as then known, into separate subsections, largely on the basis of a difference in chromosome number $n=16$ and $n=14$ or 29, respectively). However, the two are very closely related, and in my opinion the additional chromosomal and morphological variation known today make it impractical to separate them. Therefore *S. cockerellii* is conceived broadly here, to include also *S. griffithsii* and the various other binomials earlier considered synonymous with one or the other of them (Clausen and Uhl, 1943).

Thus conceived, *S. cockerellii* has at least four chromosome races (established variants), with 14, 16, 29 or 30 gametic chromosomes. Probably the lone Texas population, with $n=15$, represents a fifth chromosome race. Each of these races occupies a definite geographic area, and in no case was more than one chromosome race found in the same range of mountains (Fig. 29). One or more extra chromosomes were found in plants from six widely separated localities. These casual variants occurred in populations in which the standard numbers (as confirmed by counts from other plants in four of the six populations) were $n=14$ (2 populations), $n=15$ (1 population), and $n=16$ (3 populations). In all but one case the extra chromosomes were smaller than the regular members of the set; they sometimes differed among themselves in size (e.g., Fig. 4) and occasionally paired with each other, although usually not with members of the standard set. Most of them seem to represent typical examples of accessory or "B" chromosomes. Their origin and function, if any, are completely unknown.

In general, plants of *S. cockerellii* from south central Arizona and northern Sonora have 14 pairs of chromosomes (Fig. 1). These include typical *S. griffithsii* (C5176). One plant from the Huachuca Mountains (U887A) had two small extra chromosomes that formed a bivalent in 7 of the 23 metaphase I plates examined (Fig. 2) but remained unpaired in the remaining 16 in the same anther (Fig. 3). Another plant from the same population (U887B) had the

standard 14 pairs. Still another plant, from Sycamore Canyon, southeast of Ruby (UC65.135), had three small, extra chromosomes (Fig. 4), but six other plants collected at various times from the same locality (U884, U1824) all had the standard 14 pairs.

The lone Texas population, which I believe is a new species record for the state, has $n=15$ (Fig. 5), although one of the four plants studied had a small, extra chromosome, possibly an accessory (Fig. 6). One pair of chromosomes is large, perhaps the result of combining most of two chromosomes from an ancestor with $n=16$.

Plants of *S. cockerellii* ranging from Oak Creek Canyon in north central Arizona to the White Mountains in the east central part of the state, mostly along or near the Mogollon Rim, as well as most collections from New Mexico, have $n=16$ (Fig. 7). These include plants from the vicinity of the type locality (U1315, U1316, C5254). Constrictions, apparently kinetochores, are detectable in some chromosomes of mitotic metaphases ($2n=32$, Fig. 8). Thus there is no reason to believe that diffuse or multiple kinetochores are related to the dysploidy in this species. A plant from the White Mountains of east central Arizona had a small accessory chromosome (U1155, Fig. 9), but plants from six other localities in the same mountains all had the standard 16 pairs. One plant from the Jemez Mountains of north central New Mexico had a small accessory chromosome (U1147G) and another from the same locality (C5281) had several (six in Fig. 10), but seven other plants from the same population had the standard 16 pairs (U1147A, B, C, D, E, F, H). Still another plant, from the Sangre de Cristo Range in northern New Mexico, had probably four extra chromosomes (U1133, Fig. 11). Since these were large enough to represent standard chromosomes, and since they appeared often to enter into multivalent formation with regular chromosomes (Fig. 12), the plant is possibly a quadruple trisomic ($2n+4$), perhaps descended from a triploid.

In the Mule Mountains (near Bisbee), in the Chiricahuas,

on Mount Graham, and on Kitt Peak in the Quinlan Mountains, all in southern Arizona, *S. cockerellii* has $n=29$ (Fig. 13). Plants from the Sierra Blanca Range in southern New Mexico have $n=30$ (Fig. 14). In these two tetraploid chromosome races univalents and multivalents are formed occasionally and make it difficult to detect any casual variation in chromosome number. None was noted in the 18 tetraploid collections studied.

S. niveum is closely related to *S. cockerellii* (Clausen and Uhl, 1943). High in the San Bernardino and Santa Rosa Mountains of southern California this endemic species has $n=16$ (Fig. 15), as does one race of *S. cockerellii*. *S. niveum* has recently been discovered about 200 miles to the south, high in the Sierra San Pedro Martir of northern Baja California (Moran, 1969). Here it is octoploid, with $n=64$ (Fig. 16), but occasionally forming a few multivalents and univalents at meiosis.

At one of its two type localities, Carr Peak in the Huachuca Mountains of southeastern Arizona, *S. stelliforme* has $n=20$, plus a variable number of accessory chromosomes, two to seven in different plants, (Figs. 17, 18). Another plant, probably this species, from more than 400 miles to the southeast in southern Chihuahua, Mexico, also had $n=20$ (Fig. 19), plus one or two extra, accessory chromosomes in some cells. Very similar plants from the White Mountains of east central Arizona and from the Black Range in southwestern New Mexico are considered for the present to be also the same species, but they all have $n=12$ (Fig. 20). The cause and significance of the two different, apparently unrelated, chromosome numbers (established variants) in the species is not at all clear; perhaps closer morphological study may support their taxonomic separation. One plant from the Black Range (U1625A) had 8 small accessory chromosomes (six are shown in Fig. 21), but two other plants from the same population and plants from seven other populations in the same mountains all had $n=12$.

S. wrightii includes plants with four levels of ploidy

based on $x=12$, diploid through octoploid ($n=12$, 24, 36, and 48; Figs. 22, 24-26). No plants with accessory chromosomes or other casual variants were definitely noted, but one collection (UC52.1680) clearly had 13 pairs of chromosomes (Fig. 23), none of which was distinctively smaller than the others. Four plants collected later from what was presumed to be the same locality (U879) all had the standard diploid $n=12$. It is not certain whether the plant with $n=13$ is better considered another established variant or a casual variant. Univalents, multivalents, and close secondary associations are common enough to make exact counts difficult in some hexaploids ($n=36$) and octoploids ($n=48$). Probably these are autopolyploids. Autopolyploidy has been reported in *S. ternatum* (Baldwin, 1936; Uhl, 1970b), and, on the basis of evidence from chromosome pairing in hybrids, it appears to be common in the Mexican Crassulaceae (Uhl, 1970a, and unpub.).

The four principal chromosome types (established variants) of *S. wrightii* are not as discrete geographically (Fig. 30) as those of *S. cockerellii* and *S. stelliforme* (Fig. 29). Only diploids were found in southern New Mexico, and they occur also in the Davis Mountains of western Texas and in the vicinity of Saltillo, Coahuila, Mexico. Tetraploids ($n=24$) were found at the presumed type locality (U882, near El Paso), near Marathon, Texas, in the

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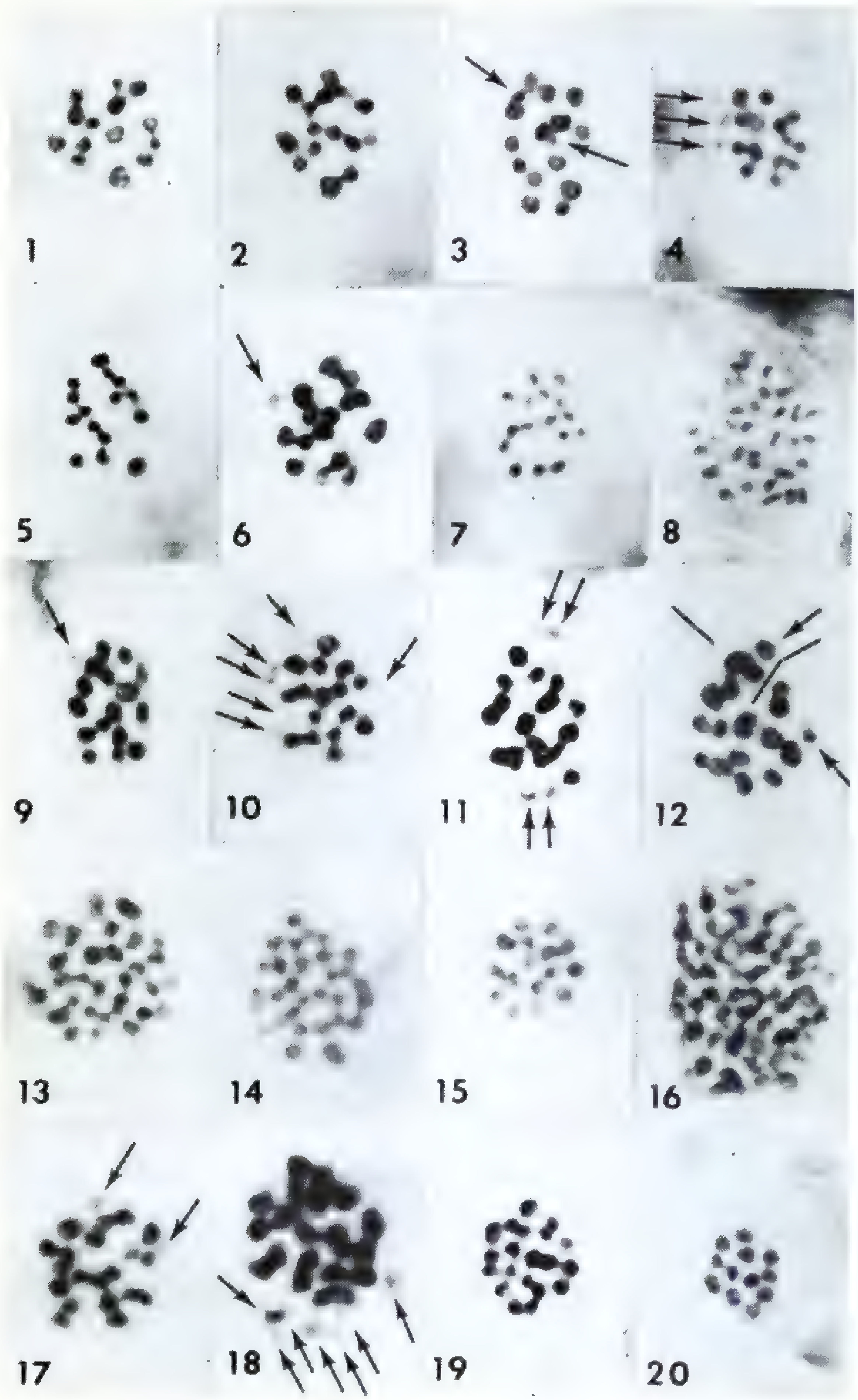
Figs. 1-20. *Sedum* chromosomes in pollen mother cells at metaphase I (except Figs. 8, 16), ×2000. Arrows identify univalents and/or accessory ("B") chromosomes. Figs. 1-14. *S. cockerellii.* Fig. 1. U883, $n=14$. Fig. 2. U887A, $n=15$. Fig. 3. U887A, $n=14+2_{I}$. Fig. 4. UC65.135, $n=14+3B$. Fig. 5. U880C, $n=15$. Fig. 6. U880B, $n=15+1B$. Fig. 7. U900, $n=16$. Fig. 8. U900, mitosis in anther wall, $2n=32$. Note constrictions (kinetochores) in some chromosomes. Fig. 9. U1155, $n=16+1B$. Fig. 10. C5281, $n=16+6B$. Fig. 11. U1133, $n=16+4B$. Fig. 12. U1133, 2_{III} (identified by lines) $+14_{II}+2_{I}$. Fig. 13. U888, $n=29$. Fig. 14. U1307, $n=30$. Figs. 15-16. *S. niveum.* Fig. 15. M345, $n=16$. Fig. 16. M15333, $n=64$ (Metaphase II). Figs. 17-20. *S. stelliforme.* Fig. 17. U1680A, $n=20+2B$. Fig. 18. U1680C, $n=20+7B$. Fig. 19. U2051, $n=20$. Fig. 20. U1312, $n=12$.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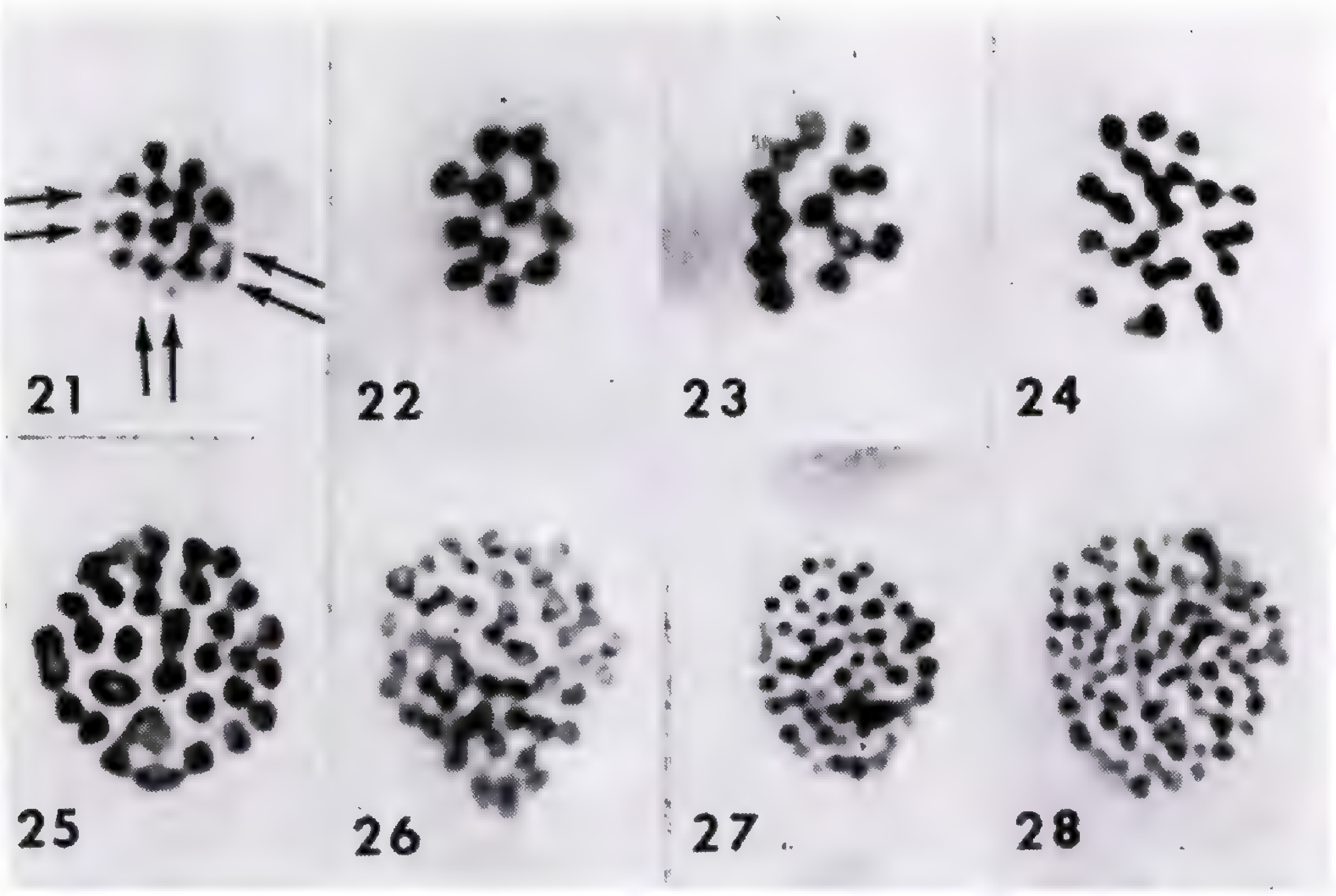

Figs. 21-28. *Sedum* chromosomes in pollen mother cells at metaphase I, × 2000. Arrows identify univalents and/or accessory ("B") chromosomes. Fig. 21. *S. stelliforme*. U1625A, $n=12+6B$. Fig. 22-26. *S. wrightii*. Fig. 22. U879, $n=12$. Fig. 23. UC52.1680, $n=13$. Fig. 24. UC53.407, $n=24$. Fig. 25. U877, $n=36$. Fig. 26. M6317, $n=48$. Figs. 27-28. *S. havardii*. Fig. 27. UC52.1679, $n=54$. Fig. 28. U876, $n=81$.

Sierra del Carmen (across the Rio Grande from Big Bend) and in the Sierra Madre Oriental in southern Nuevo Leon, Mexico. Hexaploids ($n=36$) were found at Big Bend and 135 miles to the east, near Del Rio, Texas, and octoploids ($n=48$) only in southern Nuevo Leon.

S. havardii is apparently of Mexican affinities. It is known in the United States only in the Big Bend region of western Texas, where plants with 54 and 81 gametic chromosomes have been found (Figs. 27, 28). Presumably the basic karyotype of this species consists of 27 chromosomes, but no collection with this number has yet been found. The only collection with $n=81$ (U876) was made only 1 1/2 miles from another (U875) with $n=54$. Thus it is not yet clear whether the plants with the different numbers really represent established chromosomal vari-

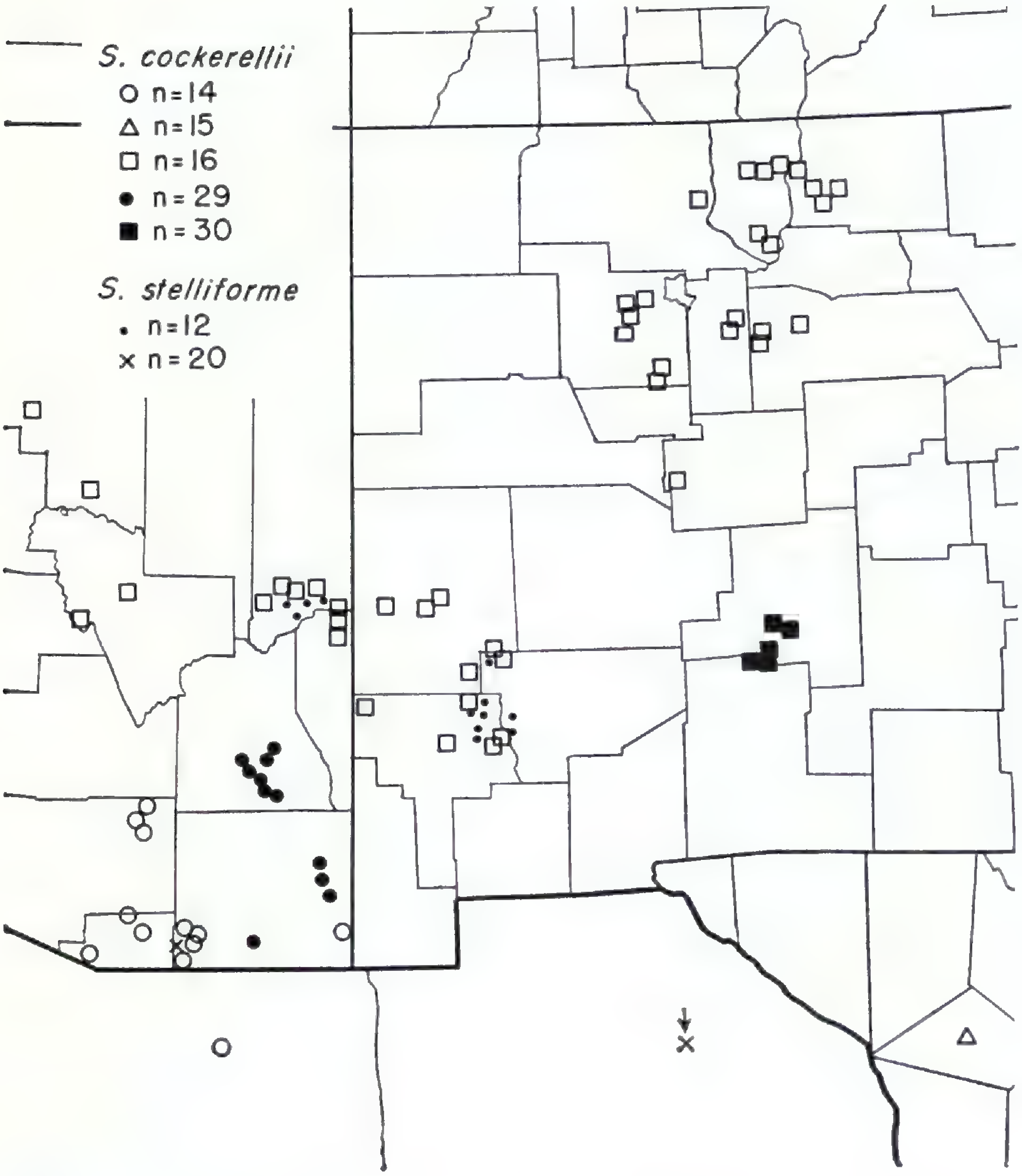

Fig. 29. Distribution of chromosome races (established variants) of *Sedum cockerellii (s. lat.)* and *S. stelliforme* in New Mexico, Arizona and adjacent regions.

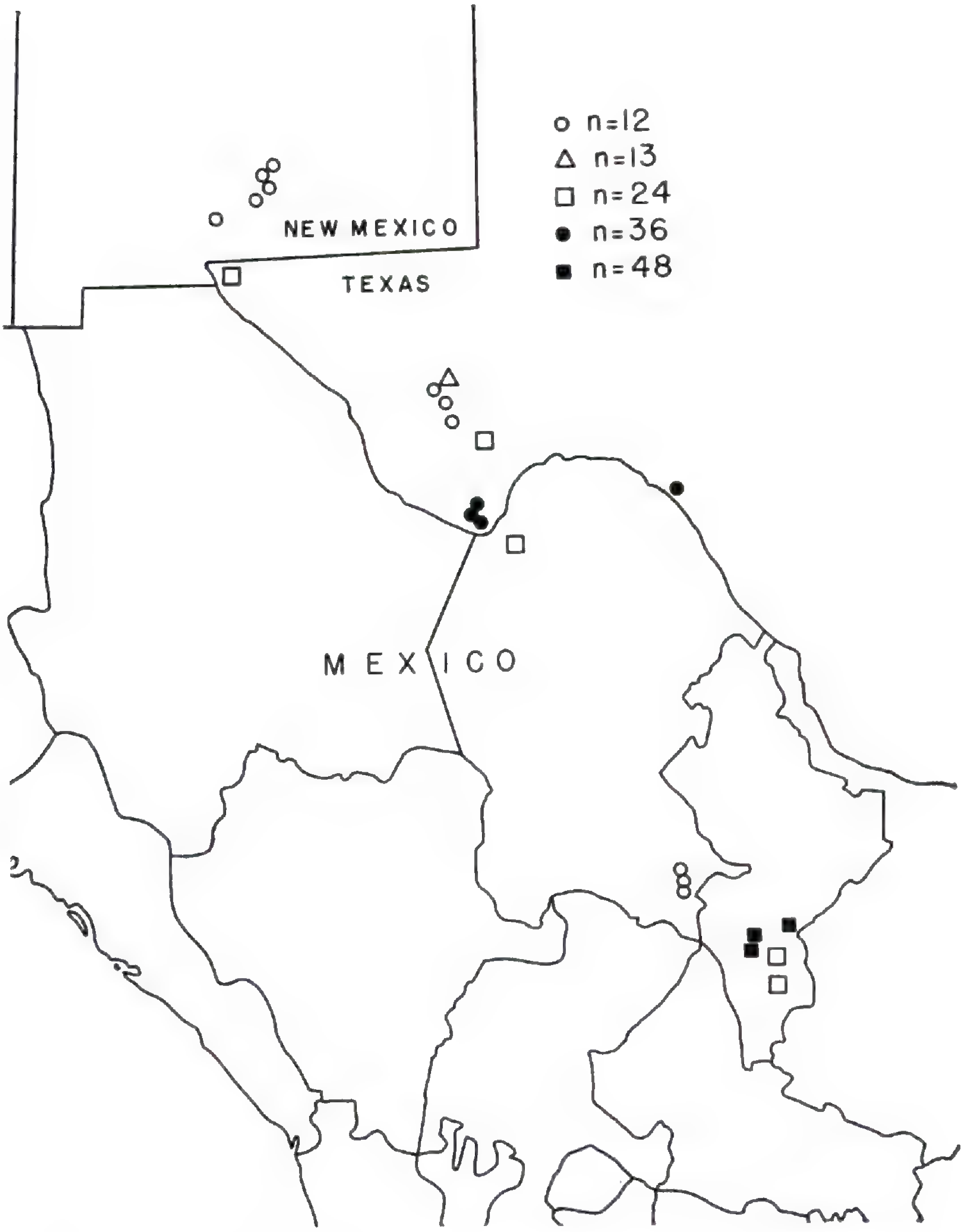

Fig. 30. Distribution of chromosome races of *Sedum wrightii* in New Mexico, Texas and northeastern Mexico.

ants (races) or only two samples from a large population containing casual variants in ploidy. Two of the most similar species are *S. diffusum* ($x=19$) of northeastern Mexico and *S. alamosanum* ($x=18$) of northwestern Mexico, both of which also have polyploid races.

Plants of *S. cockerellii* with $n=16$ (U1690) have been found within inches of *S. stelliforme* with $n=12$ (U1691) in the White Mountains, and plants of *S. griffithsii* (here included in *S. cockerellii*) with $n=14$ on Carr Peak in the Huachuca Mountains (U1679) are no more than a mile from plants of *S. stelliforme* that have $n=20$ + accessories (U1680). At two localities on opposite sides of Red River Pass in the Sangre de Cristo Range of northern New Mexico, *S. cockerellii* with $n=16$ (U1134, U1138) was found within inches of the yellow-flowered, tetraploid *S. lanceolatum*, also $n=16$ (U1135, U1139), with both species in flower together. This locality is near the northern limit of the range of *S. cockerellii,* near the southern limit for *S. lanceolatum.*

S. cockerellii was never found close to *S. wrightii,* although perhaps the two might occur together in the Davis or Organ Mountains. *S. cockerellii* generally occurs in the Transition and Canadian Zones, nearly always near streams that flow all year, whereas *S. wrightii* is generally a plant of the warmer and drier Sonoran Zone (Clausen and Uhl, 1943). However, in the Sacramento Mountains about Cloudcroft, New Mexico, diploid *S. wrightii* ($n=12$) occurs at higher elevations (four collections: 8000-8400′) than does *S. cockerellii* 20-30 miles north in the Sierra Blanca Range about Ruidoso (five collections: 7100-7600′). Each species was found in only the one range in this area and not found in the other. *S. wrightii* (hexaploid, U873) occurs with *S. havardii* (U875) in the Chisos Mountains of Big Bend National Park and with other species in Mexico.

Each of the five species has two or more chromosome races (established variants). Polyploidy definitely occurs in four of the five, and it may also account in some degree

for the difference between the races of *S. stelliforme* with $n=12$ and $n=20$ + B's. Extra chromosomes, usually accessories, were found in some diploid plants in three species. Probably this sort of casual variation should be expected where so much established variation also occurs. In the same region *Graptopetalum rusbyi* of Arizona also includes polyploids and variations from strict diploidy (Uhl, 1970a).

Apparently quite a few structural changes have occurred in the chromosomes of these species. Structural rearrangements must have been involved in the evolution of the different numbers (14, 15, 16) in diploid *S. cockerellii.* Chromosome bridges at anaphase, which usually indicate heterozygosity for an inversion, were not especially looked for, but they were common in two plants of this species (U887A and C5176).

Differences in chromosome number interfere with free interchange of genetic material and thus they represent a means of reproductive isolation that may eventually lead to new taxonomic species. However, anointing each established variant (chromosome race) as a different taxonomic species, as some (e.g., Löve, 1951) have favored for other groups, seems undesirable here. It would increase the number of species reported on from five to at least 15, and many of the splinter species probably could not be distinguished without cytological study. Thus it seems better to take a broad concept of these species. The chromosomal variants are considered to indicate that evolutionary changes are actively occurring in the five species, but the changes are considered not yet to have crossed the threshold of the practical, taxonomic species. More careful morphological study, such as that now being carried out by my colleague, Professor R. T. Clausen, may some day require modification of this conclusion for one or more of the five species.

The large proportion of chromosomal variants in these species finds a parallel in certain other species of *Sedum* in the United States, e.g., *S. glaucophyllum* and *S. terna-*

tum (Uhl, 1970b), and also *S. lanceolatum* (Uhl, unpub.). However, it contrasts sharply with the situation in still others. For example, in 78 collections of *S. spathulifolium,* ranging from Vancouver Island to southern California and exhibiting considerable variation in such characters as leaf thickness, width, crowding and glaucosity, no established variants were found, and all plants but two had seemingly identical karyotypes with $n=15$ (Uhl, unpub.). The only two exceptions were both casual variants: a plant with $n=14$ in a population that also included a standard plant, and a triploid. Seventy-nine other collections, representing five other species related to *S. spathulifolium,* also all had $n=15$, with no variants, either established or casual. However, one related species had $n=30$ and another $n=45$. It is not clear whether the relative scarcity of non-standard chromosome complements in these species means that they are produced less frequently or that they survive less well, or both. At any rate, the karyotype here has remained stable in number and probably also in form during the evolution of enough morphological diversity that six species are recognized and while spreading 1100 miles apart. This stability must reflect differences in the nature of the genetic and chromosomal changes that have contributed to evolution in *S. spathulifolium* and its relatives (subgenus Gormania), contrasted with those prevailing in most of the species described earlier.

Summary

Variation in chromosome number is found within each of five species of *Sedum* of the southwestern United States. Established variation is represented by polyploid and/or dysploid geographic chromosome races, two to five for each species. Casual variation, represented by the occurrence of occasional plants that are trisomic or that bear accessory chromosomes, was found in two, possibly three, species. Successful casual variants can become established variants (races). Although differences in chromosome number are accompanied by some degree of reproductive isolation, rec-

ognition of each chromosomal variant as a different species does not seem appropriate in these actively evolving cases.

Acknowledgement

I thank those who have provided some of the plants reported on here, especially Dr. Reid Moran, of the Natural History Museum, San Diego (M nos.), and Mr. Paul Hutchison, formerly of the University of California Botanical Garden, Berkeley (UC nos.). Publication was assisted by the L. W. Sharp Fund of Cornell University.

COLLECTIONS STUDIED

S. cockerellii Britton

Arizona:

U894 $n=14$ Pima Co. 4 mi. N. of road summit, Mt. Lemmon, Santa Catalina Mts., 6240′.

U893 $n=14$ Pima Co. 0.8 mi. below Mt. Lemmon Lodge, 7520′.

UC52.1674 $n=14$ Same locality, (E. R. Blakely).

U892 $n=14$ Pima Co., Bear Canyon, 15 mi. by road S. of Mt. Lemmon Lodge, 5480′.

U883 $n=14$ Santa Cruz Co., Madera Canyon, Santa Rita Mts., 6400′.

C5176 $n=14$ Santa Cruz Co., near summit, Baldy Peak, Santa Rita Mts., 8900′. ? Topotype of *S. griffithsii* Rose, (R. T. Clausen).

U884 $n=14$ (5 plants) Santa Cruz Co., Sycamore Canyon, 5 mi. S.E. of Ruby, Atasco Mts., 3960′.

U1824 $n=14$ Same locality, (A. M. Phillips III).

UC65.135 $n=14+3B$ Same locality, (D. M. Hutt).

U885 $n=14$ (2 plants) Santa Cruz Co., Sonoita Cr., 3 mi. S.W. of Patagonia, 3920′.

U886 $n=14$ Santa Cruz Co., Mile 16 N.E. of Nogales, 2.8 mi S.W. of Patagonia, 3900′.

U887A $n=14+2$, Cochise Co., Ramsay Canyon, Huachuca Mts., 6000′.

U887B $n=14$ Same locality.

U1681 $n=14$ Cochise Co., Reef Mine, Upper Carr Canyon, Huachuca Mts., 7100′.

U1679 $n=14$ Cochise Co., N. slope of Carr Peak, Huachuca Mts., 7700′.

C5189 $n=14$ Cochise Co. Same locality, (R. T. Clausen).

UC52.1678 $n=14$ Cochise Co., Guadalupe Canyon, Guadalupe Mts., 4300′, (E. R. Blakely).

Mexico:

M14849 $n=14$ Sonora. Cerro Colorado, S.E. of Cananea, (C. Glass and D. Gold).

Arizona:

U900 $n=16$ Coconino Co., Oak Creek Canyon, 12 mi. N. of Sedona, 5600′.

U1617 $n=16$ Coconino Co., Macks Crossing, E. Clear Cr., 15 mi. N.E. of Clints Well, 6260′.

UC52.1673 $n=16$ Gila Co., N. peak of Four peaks Mt., Mazatzal Mts., 7645′, (E. R. Blakely).

U1688 $n=16$ Gila Co., Workman Creek Falls, 44 mi. N. of Miami, Sierra Ancha, 6600′.

U1618 $n=16$ Apache Co., near dam, Hawley Lake, White Mts., 8200′.

U1694 $n=16$ Apache Co., Snake Cr., 19 mi. E. of McNary, White Mts.

U1158 $n=16$ Apache Co., 3.8 mi. N. of Greer, White Mts., 8400′.

U1690 $n=16$ Apache Co., 14 mi. W. of Alpine, White Mts., 8500′.

U1157 $n=16$ Greenlee Co., 6.6 mi. S. of Alpine, 7950′.

U1156 $n=16$ Greenlee Co., 10.3 mi. S. of Alpine, 7700′.

U1155 $n=16+1B$ Greenlee Co., 2.7 mi. N. of Hannagan Meadows, White Mts., 8800′.

New Mexico:

U1152 $n=16$ Catron Co., 10 1/2 mi. W. of Reserve, San Francisco Mts., 7200′.

U1151 $n=16$ Catron Co., Tularosa R., 1 mi. E. of Aragon, 6750′.

U1150 $n=16$ Catron Co., Tularosa R., 3 mi. E. of Aragon, 6900′.

U1621 $n=16$ Catron Co., Wall L., 9 mi. S. of Beaverhead, Black Range, 6400′.

U1619 $n=16$ Sierra Co., Poverty Can., 19 mi. N.W. of Winston, Black Range, 7500′.

U1153 $n=16$ Grant Co., 4 mi. W. of Mule Cr., San Francisco Mts., 5800′.

U1622 $n=16$ Grant Co., Black Canyon Forest Camp, 32 mi. N. of Mimbres, Black Range, 6770′.

U1309 $n=16$ Grant Co., 2.5 mi. N. of Pinos Altos, Pinos Altos Range, 6600′.

U1310 $n=16$ Grant Co., Iron Cr., 6.6 mi. W. of Emory Pass, Black Range, 6800′.

U1311 $n=16$ Grant Co., Iron Cr., 5.1 mi. W. of Emory Pass, 7200′.

U1314 $n=16$ Torrance Co., Red Canyon Forest Camp, 7 mi. W. of Manzano, Manzano Mts., 7800′.

U1148 n=16 Sandoval Co., Jemez R. at Soda Spring, 1.6 mi. N. of Jemez Springs, 6350′.

C5281 n=16+3–6B Sandoval Co., 4 mi. N. of Battleship Rock, near LaCueva, Jemez Mts., 7700′, (R. T. Clausen).

U1147 n=16 (7 plants) n=16+1B (1 plant) Sandoval Co., La-Cueva, (Probably same locality as preceding).

U1146 n=16 Sandoval Co., Jemez Falls, 7850′.

U1145 n=16 Sandoval Co., Las Conchas Forest Camp, Jemez Mts., 8400′.

U1149 n=16 Sandoval Co., Las Huertas Cr., 6 mi. S. of Placitas, Sandia Mts., 7830′.

C4633b n=16 (2 plants) Sandoval Co., Ellis Brook, N. side Sandia Mts., (R. T. Clausen).

C4633a n=16 Sandoval Co., Sandia Crest, Sandia Mts., 10,400′, (R. T. Clausen).

U1315 n=16 Santa Fe Co., 6 mi. N.E. of Santa Fe, 7500′.

U1316 n=16 Santa Fe Co., 9 mi. N.E. of Santa Fe, Black Canyon Forest Camp, 8300′.

U1143 n=16 San Miguel Co., E. side Pecos R. at bridge 6.4 mi. N. of Pecos, 7200′.

C5254 n=16 San Miguel Co., Pecos R., 5 mi. S. of Terrero, 7500′, (R. T. Clausen).

U1142 n=16 San Miguel Co., Gallinas Cr., 1/2 mi. W. of Montezuma, 6750′.

U1317 n=16 Rio Arriba Co., Rio Vallecitos, 5.5 mi. N. of La-Madera, Ortega Mts., 6900′.

U1138 n=16 Taos Co., S. side Red River, 2.7 mi. E. of Questa, 7550′.

U1137 n=16 Taos Co., S. side of Red River, 4.5 mi. W. of Red River village, 8150′.

U1136 n=16 Taos Co., Mouth of Mallette Canyon, village of Red River, 8650′.

U1140 n=16 Taos Co., S. side Rio Pueblo at Comales Forest Camp, 7850′.

U1141 n=16 Taos Co., N. side Rio Pueblo, 2.2 mi. N.W. of Tres Ritos, 8250′.

U1134 n=16 Colfax Co., 2.6 mi. E. of Red River Pass, Sangre de Cristo Range, 8900′.

U1133 n=16+4 Colfax Co., Cimarron Cr., 5 mi. E. of Eagle Nest, 7850′.

U1132 n=16 Colfax Co., Cimarron Canyon, 5 mi. W. of Ute Park, 7750′.

U1131 n=16 Colfax Co., Cimarron Cr., 1 mi. W. of Ute Park, 7550′.

Texas:

U880 $n=15$ (2 plants) $n=15+1$ (1 plant) Jeff Davis Co., Madera Canyon, 25 mi. W.NW. of Fort Davis, Davis Mts., 5800′. 1961.

U1633 $n=15$ Same locality, 1967.

Arizona:

U1685 $n=29$ 1.6 mi. SE of Columbine Ranger Sta., Mt. Graham, 9215′.

U1684 $n=29$ Graham Co., Grant Creek, Swift Trail, Mt. Graham, 8750′.

U1683 $n=29$ Graham Co., Near Snow Flat, Swift Trail, Mt. Graham, 9000′.

U1686 $n=29$ Graham Co., 1.7 mi. N.W. of Ladybug Saddle, Swift Trail Mt. Graham, 8800′.

U1682 $n=29$ Graham Co., 1 mi. below Turkey Flat, Swift Trail, Mt. Graham, 7300′.

U1926 $n=29$ Graham Co., Marijilda Canyon, Mt. Graham, 8200′, (A. M. Phillips III).

U1927 $n=29$ Graham Co., Marijilda Canyon, Mt. Graham, 4800′, (A. M. Phillips III).

C5224 $n=29$ Cochise Co., S. of Rustler Park, Chiricahua Mts., 8500′, (R. T. Clausen).

UC65.144 $n=29$ Cochise Co., 1/2 mi. below Onion Saddle, Chiricahua Mts., 7300′, (D. Hutt 1260).

U1678 $n=29$ Cochise Co., S. Fork, Cave Cr., 3 mi. S.W. of Portal, Chiricahua Mts., 5150′.

U1253 $n=29$ Cochise Co., Chiricahua Mts., (C. English).

U888 $n=29$ (2 plants) Cochise Co., 1/2 mi. N. of Mule Pass, Mule Mts., N. of Bisbee, 5840′.

New Mexico:

U1629 $n=30$ Lincoln Co., Bonito Cr., 7.2 mi. W. of Angus, Sierra Blanca, 7500′.

U1628 $n=30$ Lincoln Co., 3.1 mi. W. of Angus, 7100′.

U1307 $n=30$ Lincoln Co., Eagle Cr., 2.5 mi. W. of Alto, Sierra Blanca, 7600′.

U1304 $n=30$ Same, 1.5 mi. W. of Alto, 7450′.

U1630 $n=30$ Otero Co., Carrizo Cr., Mescalero Apache Indian Res., 2.2 mi. W. of Ruidoso, Sierra Blanca, 7200′.

S. niveum Davidson

California:

C4759 $n=16$ San Bernardino Co., Sugar Loaf Peak, S. Bernardino Mts., 7000′, (R. T. Clausen).

C4759b $n=16$ Same, Dollar Lake, 9300′, (R. T. Clausen).

U919 $n=16$ San Bernardino Co., above Jenks Lake, 8000′, (D. Verity).

M345 $n=16$ Riverside Co., Santa Rosa Peak, Santa Rosa Mts., (P. A. Munz).

M15346 $n=16$ Riverside Co., 1 mi. N.W. of Toro Peak, Santa Rosa Mts., 7450′, (R. Moran).

Mexico:

M15333 $n=64$ Baja California, Observatory Peak, Sierra San Pedro Martir, 9300′, (R. Moran).

M15682 $n=64$ prob. Same, N. slope, 8400′. (R. Moran).

S. stelliforme S. Wats.

Arizona:

U1680 $n=20+2$–7B (5 plants) Cochise Co., N.E. slope Carr Peak, Huachucha Mts., 8300′. TOPOTYPE

C5192 $n=20+2$B Same Locality, (R. T. Clausen).

U1693 $n=12$ Apache Co., N. side Crescent L., White Mts., 9100′.

U1689 $n=12$ Apache Co., Cienega Redondo, 16 mi. W. of Alpine, White Mts., 8950′.

U1691 $n=12$ Apache Co., 1 1/2 mi. W. of Three Forks, Black R., 14 mi. W. of Alpine, 8550′.

U1692 $n=12$ Apache Co., Williams Valley, 7.2 mi. W. of Alpine, 8650′.

Mexico:

U2051 $n=20+1$ or 2B Chihuahua, 55 mi. W. of San Francisco del Oro, (M. Kimnach and F. K. Brandt 1058).

New Mexico:

U1623 $n=12$ Grant Co., 1.4 mi. S. of Black Canyon Forest Camp, Black Range, 7000′.

U1624 $n=12$ Grant Co., 2.6 mi. S. of same, 7300′.

U1625 n=12 (2 plants) Grant Co., 3.3 mi. N. of Rocky Canyon Forest Camp, Black Range, 7800′.

U1625A $n=12+8$B Same locality.

U1626 $n=12$ Grant Co., 1.2 mi. N. of same, 7600′.

U1627 $n=12$ Grant Co., 2.9 mi. S. of same, 7400′.

U1312 $n=12$ Grant Co., 2.8 mi. W. of Emory Pass, Black Range, 7600′.

U1313 $n=12$ Sierra Co., 1 mi. N. of Emory Pass, Black Range, 9000′.

U1620 $n=12$ Sierra Co., N. side of Boiler Peak, 3.2 mi. W. of Continental Divide, Black Range, 7900′.

S. wrightii A. Gray

New Mexico:

U1631 $n=12$ Otero Co., Silver Springs Canyon, 7.8 mi. N.E. of Cloudcroft, Sacramento Mts., 8000′.

U1303 n=12 Otero Co., Silver Springs Canyon, 5 mi. N.E. of Cloudcroft, 8400′.

U1302 n=12 Otero Co., Cox Canyon, 5.2 mi. S.E. of Cloudcroft, 8150′.

U1632 n=12 Otero Co., Upper Peñasco Canyon, 13 1/2 mi. S. of Cloudcroft, 8400′.

C5241 n=12 Dona Ana Co., Canyon at La Cueva, Organ Mts., (R. T. Clausen).

Texas:

U882 n=24 El Paso Co., McKelligon Canyon, N. of El Paso, S. side of Franklin Mts., 5400′, TOPOTYPE.

C364 n=12 Jeff Davis Co., Fern Canyon, Davis Mts.

UC52.1680 n=13 Jeff Davis Co., 20 mi. N. of Alpine, Davis Mts., 4900′, (E. R. Blakely 1378).

U879 n=12 (4 plants) Jeff Davis Co., 5 mi. S. of Fort Davis, Davis Mts., 4800′, (Same locality as preceding?).

U878 n=12 Brewster Co., Sunny Glen, 6 mi. W.NW. of Alpine, 4800′.

U1676 n=24 Brewster Co., 3.4 mi. S. of US 90 at Marathon, 4100′.

U877, U1675 n=36 Brewster Co., Green Gulch, N. of Panther Gap, Chisos Mts., Big Bend National Park, 5600′.

U873 n=36 Upper Boot Canyon, Chisos Mts., 6900′.

UC52.1672 n=36 E. side of Emory Peak, Chisos Mts., 7000′, (E. R. Blakely 1402).

C5298 n=36 Chinese Wall, Chisos Mts., (R. T. Clausen).

U868 n=36 Val Verde Co., E. side of Devils River, 8 mi. N.W. of Del Rio, 1100′.

UC54.1334 n=36 Same locality, (J. B. Perry).

Mexico:

UC53.407 n=24 Coahuila, 8 mi. S.W. of Piedra Blanca, Sierra del Carmen, 7000′, (Ward Russell).

U1497 n=12 Coahuila, Chorro Canyon, 27 km. S.E. of Saltillo, ca. 6500′.

U1501 n=12 Coahuila, Chorro Canyon, 33 km. S.E. of Saltillo, ca. 7000′.

M7825 n=12 Coahuila, Chorro Canyon, (R. Moran).

M6317 n=48 Nuevo Leon, San Jose de Raices, (R. Moran).

U1494 n=45-48 Nuevo Leon, 6 km. S. of San Jose de Raices, 6100′.

U1916 n=48 Nuevo Leon, 3 km. W. of Iturbide, 5400′.

U1914 n=24 Nuevo Leon, 16 mi. N. of Ascension, 7900′.

U1912 n=24 Nuevo Leon, 30 mi. N. of Doctor Arroyo, 4 mi. N. of La Escondida, 5900′.

Sedum havardii Rose

Texas:

U875 $n=54$ Brewster Co., Chisos Mts., Big Bend National Park: N. of Boot Spring, 6900′.

U876 $n=81$ 1 1/4 mi. S. of Boot Spring, 7000′.

UC52.1679 $n=54$ E. side of Emory Peak, 7000′, (E. R. Blakely).

U1674 $n=54$ Above E. side of Panther Pass, N. side of Casa Grande, 6200′.

C363 $n=54$ Green Gulch, 5500′.

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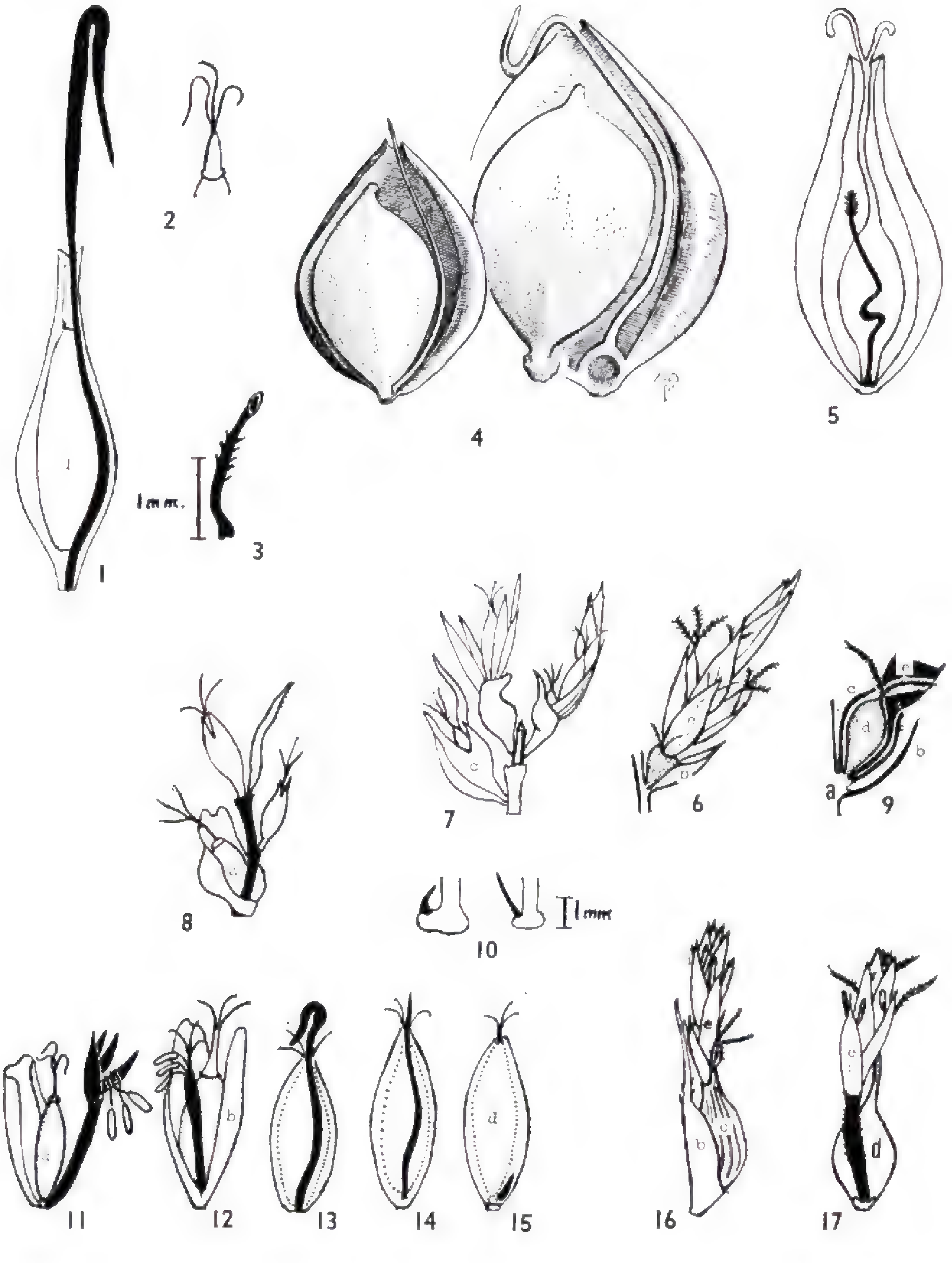
THE RACHILLA IN CAPE COD SPECIES OF CAREX WITH NOTES ON THE HISTORY OF THE PERIGYNIUM AND RACHILLA

Henry K. Svenson

This account takes up the local occurrence of the peculiar bristle-like or spikelet-bearing structure within the perigynium of *Carex*, known as the "rachilla". There is a review of various opinions, especially those of Duval-Jouve, Holttum, and Raymond. There is also a discussion of the relationship of *Cymophyllus* to *Carex* and to the West Indian *Bisboeckelera*. A plate with many figures illustrates the various interpretations of the rachilla.

It was a surprise to find on Cape Cod, in southeastern Massachusetts, *Carex* with development of the rachilla. First detected was *Carex Emmonsii,* which appeared peculiar to the naked eye. It grew in rich soil with skunk cabbage along the so-called Marston Mills River. The microscope showed that spikelets, developing within the perigynium, had extended out of it, a characteristic of *Schoenoxiphium.* This is a genus of sedges mainly South African. Further observation showed that this condition is not rare in *Carex Emmonsii* in dry sandy fields. *C. Emmonsii* is the commonest *Carex* on Cape Cod, and easily recognized by the tufts of long recurving leaves, which remain over winter. It grows especially well where the soil has been disturbed. The same rachilla structure is found, though less abundantly, in robust specimens of the closely related *Carex pensylvanica.* In a sandy field in Osterville, both species, together with rachilla-bearing *C. scoparia,* grew in a field being overrun by *Robinia viscosa, Prunus serotina,* and *Euonymus europaea.* Further good examples of *C. pensylvanica* were found in sandy fill near Johns Pond in Mashpee.

This axis within the perigynium assumes various forms, most commonly as a small bristle, but also as the schoenoxiphoid condition mentioned above (see fig. 7). On Cape Cod I have seen the rachilla in *C. scoparia, C. Swanii, C. debilis*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var. *Rudgei, C. bullata, C. canescens, C. Emmonsii* and *C. pensylvanica.* There are undoubtedly more. The figure of *C. complanata,* collected by me in Tennessee, was drawn by Miss Purdy about 1940. It has a rachilla reminiscent of a hookless *Uncinia.*

The rachilla in *Carex* was first noted by Kunth (1788-1850), who correctly interpreted it. The problem is illustrated in figs. 11-15, where rachillas are shown in the series *Schoenoxiphium* to *Carex,* based on figures from Kukenthal (1909), Das Pflanzenreich: Cyperaceae-Caricoideae; and from R. S. Snell (1936). Anatomy of the spikelets and flowers of *Carex, Kobresia,* and *Uncinia,* in Bull. Torrey Club 63: 277-295. In *Carex,* as in fig. 15, the rachilla is commonly reduced; but see fig. 4, *C. complanata,* and fig. 5, *C. scoparia.* There are many examples in Boott's (1858), "Illustrations of the Genus *Carex*". In many of his illustrations the rachilla is flat with a serrated margin. That of *C. Fraseri* is strap-shaped without serrations. That of *S. scoparia* (my fig. 5) is perhaps closest to *C. Camposii* (t. 574) from the Sierra Nevada of Spain, which Kueken-

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Figs. 1-17. The rachilla (except in 4) is black. Axis of spikelet, *a*; scale (glume, *b*; perigynium, *c*; achene, *d*. Fig. 1. *Uncinia uncinoides,* × 10, Hawaii, *Svenson,* Sept. 5, 1960; 2. style-base enlarged. 3. Rachllla of *Carex tonsa,* Osterville, Mass., *Svenson,* June 10, 1967. 4. *Carex complanata,* × 10, Altamont, Tennessee, *Svenson,* Oct. 3, 1935 (drawn by Maud H. Purdy). 5. *Carex scoparia,* × 10, Osterville, *Svenson* 2933, June 23, 1970. 6. *Carex pallescens,* × 5, from Duval-Jouve, pl. vii, f. 8. 7. *Carex Emmonsii,* × 5, *Svenson,* June 16, 1967 (lowest scales removed). 8. Same collection as 7 (all scales removed). 9. *Carex pallescens,* × 10, from Duval-Jouve, pl. vii, f. 9 (perigynium bisected longitudinally). 10. *Carex debilis* var. *Rudgei,* Osterville, *Svenson,* Aug. 18, 1967. 11-15. Diagrammatic sections to show rachilla of 11, *Schoenoxiphium*; 12. *Cobresia*; 13. *Uncinia*; 14. *Carex microglochin*; 15. Carex (with reduced rachilla); all from Snell (1936) and Kuekenthal (1909). 16. *Schoenoxiphium rufum,* × 6, from C. B. Clarke, t. 141, f.2 17. The same, with perigynium removed, f. 3.

Dissections and samples of material from Cape Cod are filed on a sheet in the cover of *Carex Emmonsii* from Barnstable County in the herbarium of the New England Botanical Club.

thal places in the section *Elatae,* not represented in America. But none of Boott's plates illustrate a rachilla in the Ovales. By Barros (1935), Cyperaceae of Argentina, in Anales Mus. Ciencias Nat. Hist., the rachilla is shown in 4 species.

The best account of these contradictory structures is by Duval-Jouve (1864): Sur la signification morphologique d'une anomalie qué présentent les utricules de quelques *Carex,* in Bull. Soc. Bot. France. 1864. 19 pp. 1 pl.[1] Since the structures are similar to those that I have found, and since many species treated by him are also in New England, I have given his account the most extended treatment. In the spring of 1864, Duval-Jouve first found *Carex pallescens* with peculiar compound spikes, and spikelets issuing from the perigynia. Altogether he records a list of 24 species with a rachilla, obtained from the vicinity of Arles and Strasbourg. The anomalous spikelets were found most frequently toward the base of the spike, sometimes in the middle (*C. acuta, C. pseudocyperus,* but only rarely toward the apex. In *C. flacca*[2], *C. Oederi, C. flava,* and *C. hirta,* compound spikelets were so abundant that in some localities it was almost impossible to find a plant without them. In *C. flacca* the rachilla appeared most often as the *Schoenoxiphium*-type. In *C. flava* the perigynia were often split,

[1]N. J. Duval-Jouve (1810-1883). For biography see Flahault, Bull. Soc. Bot. France. His work is typical of the best of French botanists. He is perhaps best known for his work, illustrated in color, of *Equisetum hiemale.* All is as though inlaid with gold. His work on *Carex* is equally as good. As a forerunner of botanical work he wrote a "Traite de Logique, ou Essai sur la theorie de la Science", Paris (1848), and a second edition, which I have seen, in 1885. It treats of various kinds of observations, perceptions, evidence. etc., things which often today tend to be forgotten. Surely no other botanist was so well prepared for his scientific task. I did not, however, find a history of the transition of nomenclature from logic to biology, in which I was particularly interested.

[2]Now a very abundant and variable species throughout the gypsiferous region (about Windsor), often growing in grassy pastures near the gypsum cliffs. Roland, Fl. Nova Scotia (1947), p. 230.

resembling *Elyna spicata*. All species were in places highly modified by pastures, ditches, animals, and in many other ways. They were best developed on terrain newly disturbed, or where traces of modification were apparent. On Cape Cod, *Carex pallescens*[3] is common in grassy places, but I have yet to find a specimen with a rachilla.

The achene in *Carex* represents the lowest element of a reduced axillary inflorescence, and the achene occupies a basal lateral position at the lower part of the perigynium. This axis (the rachilla) when present is commonly bristle-like, or it may have several flowers as in *Schoenoxiphium*. Presence and development of the rachilla and the origin of the perigynium have been the subject of intensive study — one of the unfilled crossword spaces in the Cyperaceous organization. It is generally conceded that the perigynium consists of a single scale, and not the union of two scales. Torrey, in North American Cyperaceae (1838), p. 404, noted in a specimen of *C. Willdenowii* that the perigynium of the lowest flower enclosed the peduncle of a separate staminate spike. The two remaining pistillate flowers had within the perigynium, in place of a staminate spike, a green squamaceous rudiment. "This curious plant, therefore, seems in a manner to connect Schoenoxiphium *N. ab E.* with Uncinia, and to explain the nature of the setaceous body in the latter genus".

Theodore Holm (1854-1932) provides a bibliography of 55 items on the perigynium, together with an excellent account of terminology, in Am. Journ. Sci. ser. II. 214-220 (1896) entitled "The cladoprophyllum and anthopro-

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[3]The var. *neogaea* Fernald (Rhodora 44: 306. 1942) is supposed to be without a short beak at the apex of the perigynium; but Boott (1858, pp. 39, 40) says the beak may be present or absent, and he shows a beak in t. 450, illustrating a specimen from Rhode Island. Kuekenthal (1909, p. 433) describes the perigynium as erostrate except in var. *glaberrima* which has "utriculae interdum brevissime rostratae". The American var. *neogaea* therefore does not appear to amount to much. On Cape Cod, and otherwise in Massachusetts as I have seen it, *Carex pallescens* does not have the appearance of a native species.

phyllum in *Carex*", and the accompanying plate shows schoenoxiphoid spikelets in *C. crinita* and *C. Sprengelii.* Holm was one of the ablest of American botanists, who combined precise taxonomy with morphology; he was also an excellent artist. One of the latest accounts is by Holttum: "The spikelet in Cyperaceae" in Bot. Review, vol 14 (no. 8) 525-541. 1948. He, likewise, reviews the history of the perigynium. Much of the interest in the subject comes from the fact that *Carex* is one of the world's largest genera, and because it is abundant in the north temperate region. 267 species are listed in Gray Man. ed. 8; 793 species in Kuekenthal's world-wide treatment (1909).

The development of the perigynium is almost like a second evolution of the seed plants. The developing embryo has been protected within the perigynium. Dispersal of mature perigynia is by floating, flying, attachment to men or animals, or in many other ways. This protection has emancipated *Carex* from the tropics, which (according to Holttum and to Raymond) is its primitive home, and allowed its penetration into areas freed from the Pleistocene ice. Raymond (1959): Carices indochinenses necnon siamenses. Mém. Jard. Bot. Montreal, no. 53, mentions the *Careyanae* and *Pandophyllae* as perhaps the most primitive elements of *Carex.* The *Careyanae* were segregated by him from the *Laxiflorae,* which are characteristic sedges of the Appalachian forest of southeastern United States.

As Fernald says (Rhodora 5: 249. 1903) the genera of the *Cariceae* are not very good: "Besides the genus Carex the members of the *Cariceae* have been grouped by different modern authors into various ill-defined genera varying with the personal equation". But that is also true of other genera in the Cyperaceae. The presence of the rachilla in widely diverse species of *Carex* led Duval-Jouve to suspect that the rachilla might not be of phylogenetic significance, but merely atavistic remnants appearing sporadically. Thus the occurrence of the rachilla in many species of *Primocarex* led to the early idea that *Primocarex* was prim-

itive. It is interesting in this respect to compare the rachilla of *C. complanata* (fig. 4) with *Uncinia* (fig. 1).

Of interest is the lack of an articulation or joint in the style of the *Vesiculares* (in which the perigynium is highly adapted for floating), and in the *Ovales*[4] (in which it is wind-distributed). The *Ovales* have their great distribution on the Atlantic coastal plain and in Pacific North America, cf. chart by Kuekenthal (1909) p. 14, and the recent fine treatment by Hermann (1970): "Carices of the Rocky Mountains and Colorado Basin". Nelmes: "Facts and Speculations on phylogeny in the tribe Cariceae" in Kew Bull: (1961) 427-436, explained that some unispicate species were of uncinoid origin, and he distributed most of Kuekenthal's *Primocarex* variously in the genus. And to emphasize the ill-defined genera, Kuekenthal (1940) described *Schoenoxiphium kobresioides* from material collected by Van Steenis in Sumatra, and termed it the "Verbindungslied zwischen *Schoenoxiphium* und *Kobresia*".

Holttum thought *Mapania* to be the most primitive genus. See also my comments on *Mapania macrophylla* in Bull. Torr. Club 75: 95. 1948, with fig. 3. The breakdown of the tubular translucent corolla provides us with a possible origin of the perigonial bristles in the *Cyperaceae.* I was incorrect in ascribing *M. macrophylla* to Santo Domingo as well as British Guiana. Meyer's plants all came from the Essequibo River in British Guiana.

Mackenzie set up *Cymophyllus,* based on *Carex Fraseri.* By Pursh it was considered a *Mapania,* but I believe it to be a true *Carex,* illustrated by Boott (t 484) with a strap-shaped rachilla. There is a reduction series in the West Indies from *Mapania* and *Hypolytrum* to *Bisboeckelera (Hoppia)* and *Calyptrocarya,* which simulates *Carex*; but I think it is an unrelated parallel series, as shown by the various illustrations in Clarke's "Illustrations of Cypera-

[4]The style is said to be jointed by Mackenzie, and is so illustrated in North American Cariceae (1940), but I have not found it so. See fig. 5).

ceae" (1909). In my illustration of *Mapania sylvatica,* the type of the genus, in "Cyperaceae of Panama", the corolla segments are inrolled around the stamens. This I am sure is the correct interpretation, and the flower is a normal flower of the Cyperaceae, and not an assemblage of "partial inflorescences". (Ann. Missouri Bot. Gard., 1943)

Another interesting structure in Carex is the style-base, which is sometimes swollen and articulated. Duval-Jouve described *C. oedipostyla,* i.e. with a "swollen foot" in Mém. Acad. Sci et Lettres de Montpellier (1870), including a plate with many figures. The articulating style-base is widespread in *Eleocharis* and some other genera, but has little real significance in their delineation. It is one of the historical straws grasped by the drowning botanist. Some decades ago I thought that the swollen style-base in the *Laxiflorae* might be a transition to broadleaved *Cyperus (Mariscus)* of the tropical rain forest, and especially to *Cyperus diffusus.* The structure of the achene and prophyllum in *Carex* (including perhaps *Schoenoxiphium*), is closer to *Cyperus* than to any other genus. In visiting Nicaragua last spring, I found *Cyperus diffusus* to be a roadside and plantation weed, and not a rain forest type. It is probably different in the Old World.

Schoenoxiphium is generally considered to be the most primitive of the *Caricoideae,* and the accompanying figures from Kuekenthal, Snell, and Clarke show the ideas presented. It is a small genus centering on South Africa, and extending to the mountains of Madagascar, southern Siberia just north of Afghanistan (Krechetovich in Flora Tadzhikskoi USSR 2: 10-12. 1963), and to Sumatra. D. M. Napper, in Journ. East Afr. Hist. Soc. and Corydon Museum, Nairobi, 24 (no. 2); 1963, p. 12, says "predominantly South African, about 15 species. The normal habitats are damp forests and wooded or open grasslands. It is unusual for *Schoenoxiphium* to occur at the higher altitudes (over 7,000 or 8,000 ft.) where *Carex* usually occurs".

The *Caricoideae* include *Schoenoxiphium* Nees (1832), *Kobresia*[5] Willd. (1809), *Elyna* Schrader (1806), *Uncinia* Persoon (1807), and Carex[6] Linnaeus (1753).

Kobresia has according to Kukenthal (1909) its origin and central point in the high mountains of central Asia from Turkestan to Central China. 14 of the species are peculiar to the Himalayas, especially the western part, and 5 to the high mountains of Central China. The few North American species are well treated (with photographs) by Dunan in Bull. Torrey Club 83: 192-195. 1956; and in *K. simpliuscula* rachillas are shown. According to Mackenzie, *Kobresia* extends from Newfoundland and Greenland to Colorado and Alaska. *K. elachycarpa* Fernald was described in 1897 from banks of the Aroostook River at Fort Fairfield in Maine, but later treated by him as *Carex elachycarpa,* which goes to show how tenuous are the limits of these genera.

Uncinia has been well treated by Kuekenthal (1909) and consists of 24 species mainly of the southern hemisphere from the Antarctic Islands through the South American Andes to Mexico and Jamaica. The remainder is in Australia, Tasmania, New Zealand, New Guinea, and the Hawaiian Islands. The illustrated specimen (fig. 2) was collected by me in the Hawaiian Islands.

Carex microglochin Wahlenberg is illustrated in fig. 4. It extends from Greenland to Alaska, southward to Quebec and Colorado. It is also known in the Patagonian region and in Eurasia. In describing the occurrence in Newfoundland, Fernald in Rhodora 28: 61. 1926, says "It is one of the rarest and taxonomically most interesting of species, having the primitive rachilla, which is obsolete in most

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[5]According to Kuekenthal, named for the botanophile Paul de Cobres of Augsburg. It is sometimes spelled with a "C".

[6]Duval-Jouve (1864, footnote p. 16): The word *Carex* was used by Virgil, Columella, Calpurnia, etc., to designate hard, sharp, or cutting herbs . . . perhaps tall *Juncus*, *Typha,* or *Sparganium,* or perhaps dry thickets at the borders of pastures, i.e. "Frondibus hirsutis et carice pastus acuta" thickets which the shepherds of Provençal still call *carigues.*

northern *Carices*, projecting from the top of the perigynium; in other words, *C. microglochin* is an excessively local relic-species now known only in a few remote corners of the globe, and about as well placed in the Antarctic genus *Uncinia* as in the genus *Carex*, which abounds in the northern hemisphere . . . its prickly little fruit had obviously been spread by pedestrians with their high skin boots."

Now, with all these contradictory views, and the questionable relationship of the various elements, it is hoped that the reader will go out to collect some rachilla material for himself, and will then turn to Fernald's amusing story of *Carex microglochin* in the twenty-eighth volume of Rhodora.

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DISTRIBUTION OF NATIVE AND INTRODUCED KNAPWEEDS (CENTAUREA) IN CANADA AND THE UNITED STATES[1]

R. J. MOORE

The genus *Centaurea* (family Compositae, tribe Cardueae) is a large and taxonomically complex group of at least 500 species, centered in the Mediterranean region. The great majority of species are Eurasiatic but two species are native to the southwestern United States and a few others are native in northern South America. A number of Old World species are naturalized, to varying degrees, in Canada and the United States.

During the course of studies of the species found in Canada, data concerning the genus in the United States have been brought together from the literature and from herbarium collections examined. Floras of various areas of the United States treat the species found in their range but there is no complete inventory of United States species. Moreover, there is obvious disagreement between authors regarding the nomenclature and taxonomy of certain species and uncertainty as to the occurrence of a few species in the country. Boivin (1966-67) has listed the species found in Canada and we have discussed the morphology and distribution of these species in a study of the tribe Cardueae (Moore and Frankton, 1972).

In the following key is given the diagnostic characters of the taxa which have been reported or have been found to occur in Canada and the United States. Brief notes regarding taxonomy, common synonymy and a summary of the distribution are added.

The identification and distribution of Canadian plants have been verified from herbarium collections, notably those of the following institutions: Department of Agriculture, Ottawa (DAO); National Museum of Canada (CAN); Montreal Botanic Garden (MTJB); Botanical Institute , University of Montreal (MT); University of Brit-

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[1]Contribution no. 892 of the Plant Research Institute.

ish Columbia (UBC); British Columbia Provincial Museum, Victoria (V). Information regarding United States species has been compiled from the commonly known recent floras, some of which are cited here, and from herbarium specimens examined in the course of studies of the Cardueae of Canada. Specimens have been borrowed from the Gray Herbarium of Harvard University (GH), New York Botanical Garden (NY), and the University of Vermont (VT) to resolve certain specific problems. Verification of United States records which appear to be credible has not been attempted. The various North American introductions have been compared with European specimens of the taxa in our herbarium (DAO). Specimens of all the taxa discussed here have been seen, but in the cases of a few rarer species *(C. eriophora, C. diluta, C. nervosa)* only Old World specimens were available for study.

Since most of the species are adequately described in available floras, descriptive comments are here appended only in cases where there is disagreement with the concepts expressed by most authors or to emphasize points of distinction between species.

The genus *Centaurea* is here treated *sensu lato,* as is the most common practice in North America. As indicated by synonymy, some of the species are often placed in segregate genera.

DESCRIPTIVE CHARACTERS

Some discussion of the characters used in the following key may be helpful. The phyllaries (involucral bracts) take many forms in the genus and are very useful as diagnostic characters since they are present and easily examined in all flowering specimens. The innermost row of phyllaries is frequently unlike the outer rows and descriptions here refer to the more conspicuous outer 2 or 3 rows, unless otherwise stated. An apical spine is considered to be a rigid pointed apical structure that is distinctly longer than any lateral points that may be present on the phyllary. Phyllary margins (as distinct from the phyllary

apex) may also bear spines, which are pointed rigid structures, unlike the wiry, more or less flexible marginal processes seen in the condition described as pectinate, or the serrations of membranaceous or chartaceous margins. In many species the apical portion of the phyllary is expanded into a structure (appendage) that is distinctly broader than the phyllary base (blade). In our species the appendage is either pectinate or chartaceous and with entire or lacerate margins. The flower heads may consist wholly of perfect tubular florets, all similar in size, or of shorter, perfect central florets surrounded by a peripheral row of longer, sterile tubular florets, which simulate ray florets. In the key, these conditions are described as eradiate (all florets similar) or radiate (short central and longer peripheral florets — actually a falsely-radiate condition).

KEY TO SPECIES

a. Outer and mid involucral phyllaries terminated by a distinct spine (very short in *C. salmantica* and *C. diluta*); with or without marginal spines as well. (b)
  b. Marginal spines or processes absent. (c)
    c. Apical spines more than 5 mm long (usually 10-25 mm). (d)
      d. Stems winged (decurrent leaf bases); flowers yellow (Sect. *Mesocentron* DC.) (e)
        e. Apical spines pinnately spinose (bearing several lateral spinules on the shaft); phyllaries arachnoid. (f)
          f. Apical spines 5-10 mm long; involucre about 15 mm high 1. *C. melitensis*
          f. Apical spines more than 10 mm long; involucre approx. 20 mm high .... 2. *C. eriophora*
        e. Apical spine palmately spinose (without spinules on the shaft but with 2-5 pairs of palmately arranged basal spinules); phyllaries glabrous. (g)
          g. Heads 35-40 mm high, involucre 20-

25 mm high, 15 mm broad; tips of inner phyllaries not dilated; achenes approx. 4.5 × 3 mm; pappus dark brown .... 3. *C. sulphurea*

g. Heads 20 mm high, involucre 15 mm high, 10 mm broad; tips of inner phyllaries chartaceous and dilated; achenes approx. 3 × 1.5 mm; pappus white . ... 4. *C. solstitialis*

d. Stems not winged; flowers pink to purple (Sect. *Calcitrapa* Cass.). (h)

h. Involucres longer than broad (length 12-17 mm; L/W approx. 2.5); heads sessile or subsessile; pappus absent .... 5. *C. calcitrapa*

h. Involucre globular, about as long as broad (length 11-14 mm); heads pedicellate (pedicels 10-50 mm long); pappus about 2 mm long .... 6. *C. iberica*

c. Apical spines 1-5 mm long (i)

i. Apical spines 3-5 mm; phyllaries sericeous, margin dark pigmented .... 7. *C. muricata*

i. Apical spines 1-2 mm; phyllaries glabrate, margins not pigmented. (j)

j. Phyllary tips dark, terminated by a 1 mm spine or sometimes merely mucronate; margin entire .... 8. *C. salmantica*

j. Phyllary tips not pigmented, with a 1-2 mm spine and a small chartaceous, palmate-lacerate appendage; margin narrowly scarious .... . . 9. *C. diluta*

b. Marginal spines or processes (at least 4 pairs) present, in addition to the apical spine (Sect. *Acrolophus* Cass.) (k)

k. Heads radiate (but peripheral florets only slightly larger than the inner florets); marginal processes straight or curved and somewhat flexible,

phyllary tip and margin pigmented, forming a dark V-shaped mark. (l)

l. Involucres 6-8 mm broad, globose and rounded at the base; heads borne in corymbs or corymbose panicles, the branches not strikingly straight and stiff in appearance . . . . 10. *C. maculosa*

l. Involucre 4-6 mm broad, distinctly longer than broad and the base usually tapering; heads borne in panicles on stiffly diverging branches . . . . 11. *C. paniculata*

k. Heads eradiate; marginal spines straight and stiff, phyllary margins not pigmented in a V-shaped marking but occasionally with a dark irregular apical mark. (m)

m. Heads 14-16 mm high; achenes 2.3-2.5 mm long, pappus absent or short (1 mm); flowers usually white but sometimes yellow, pink or mauve . . . . 12. *C. diffusa*

m. Heads 12-13 mm high; achenes 2.5-3 mm long; pappus present (to 2.5 mm); flowers pink or mauve . . . . 13. *C. virgata* var. *squarrosa*

a. Outer phyllaries not terminated by a conspicuous, stiff spine which is longer and more prominent than any marginal processes (margins pectinate, lacerate or entire) (n)

n. Phyllaries bearing an apical appendage (an abrupt expansion of the phyllary blade, broader than the base of the blade) (o)

o. Heads small (to 4 cm broad) (p)

p. Involucres approximately as long as broad; phyllary appendages broad and completely covering the bases of adjacent phyllaries (q)

q. Appendages brown and papery, with lacerate margins . . . . 14. *C. jacea*

q. At least some of the appendages pectinate

(wiry marginal processes), appendages black or dark brown (r)

r. Apex of appendages extended into a very long, recurved process and with numerous long lateral processes, feather-like in appearance (s)

s. Plants rarely branched, bases of upper leaves truncate and almost clasping; involucres 20-24 mm high; achenes 4-5 mm, pappus 2.5-3 mm long . . . . 15. *C. nervosa*

s. Plants usually branched; leaf bases tapering; involucres about 15 mm long; achenes 3-3.5 mm long, pappus 1 mm . . 16. *C. austriaca*

r. Apex of appendages appressed and not extended into a long recurved tip (t)

t. Heads eradiate; pappus present (short, 0.5 mm but fully developed); appendages black, wiry processes long, 2-3 × width of the blade, completely covering the adjacent phyllaries . . . 17. *C. nigra*

t. Heads eradiate or radiate; pappus absent or vestigial (few short bristles); appendages brown (not dark brown) and variable from pectinate to chartaceous-lacerate, appendages broad, covering adjacent phyllaries . . . . 18. *C. × pratensis*

p. Involucre longer than broad (L/W = 1.5); phyllary appendages smaller and not completely obscuring adjacent phyllaries (u)

u. Appendages black or dark brown, small and usually triangular, not concealing the contrasting green phyllary blades; rameal

leaves narrow and smaller than the cauline leaves . . . . 19. *C. nigrescens*

u. Appendages dark brown, to twice the width of the phyllary base and almost covering adjacent phyllary bases; rameal leaves not clearly differing in size from the cauline leaves . . . . 20. *C. dubia*

o. Heads large (over 4 cm broad) (v)

v. Phyllary appendages chartaceous and palmately lacerate; heads eradiate, flowers yellow . . . . 21. *C. macrocephala*

v. Appendages pinnately pectinate; heads radiate, flowers purplish (w)

w. Phyllaries brown, appendages bearing 8-12 pairs of cilia . . . . . 22. *C. rothrockii*

w. Phyllaries straw-colored and sometimes purple-tinged, appendages bearing 3-8 pairs of cilia . . . . 23. *C. americana*

n. Phyllaries lacking an apical appendage (x)

x. Phyllary margins papery, either entire or lacerate but not pectinate (y)

y. Phyllary margins essentially entire, not lacerate (z)

z. Heads to 2 cm high, eradiate . . 24. *C. repens*

z. Heads to 4 cm high, radiate . 25. *C. moschata*

y. Phyllary margins regularly dentate-lacerate (aa) (Sect. *Cyanus* DC.)

aa. Leaves elliptic, oblanceolate, 10 mm or more wide; heads over 3 cm broad . . . . 26. *C. montana*

aa. Leaves linear, lanceolate, to 3 mm wide; heads to 3 cm broad . . . 27. *C. cyanus*

x. Phyllaries pectinate (with wiry marginal processes) (Sect. *Lopholoma* Cass.) (bb)

bb. Heads eradiate; foliage hoary . . . . 28. *C. cineraria*

bb. Heads radiate; foliage glabrous . . . . 29. *C. scabiosa*

NOTES ON SPECIES AND THEIR DISTRIBUTION

1. *C. melitensis* L. Maltese Centaury, Tocalote, Croix de Malte; common: U. S. — west coast, Ariz., N. M., Texas, established in the western states, occasional and perhaps not persisting in the central and eastern states (Steyermark, 1963; Fernald, 1950); Canada — Vancouver Is., B. C.

2. *C. eriophora* L. Rare: U. S. — Cal. Only one 1909 collection from Los Angeles is reported (Howell, 1959).

3. *C. sulphurea* Willd. (*C. sicula* of Cal. authors, according to Howell (1959); rare: U. S. — Cal.

4. *C. solstitialis* L. Barnaby's Thistle, Yellow Star-thistle, Centaurée du Solstice; common: U. S. — probably in all states, weedy in the southwest; Canada — sw Ont., Man., Sask.

5. *C. calcitrapa* L. Purple Star-thistle, Caltrope; common: U. S. — southeastern states to N. Y. (Fernald, 1950), west coast (Abrams & Ferris, 1960), Ariz. (Howell, 1959), Ill. (Jones & Fuller, 1955); Canada — sw Ont., Vancouver Is., B. C.

   Howell (1959) records that a similar plant, possibly to be called *C. calcitrapoides* L., had been collected in Riverside Co., Cal. We have a collection from Humboldt Co., Cal. (*Tracy* 16769 — DAO) which may be *C. calcitrapoides*, since a sparse pappus is present. This species differs from *C. calcitrapa* in the taller habit and the presence of a short pappus.

6. *C. iberica* Trev. in Spreng. Iberian Star-thistle; rare?: U. S. — Cal. Howell (1959) reports this species as rare in 3 counties of Cal., first collected in 1924. Several west coast floras list it for Cal. only.

   This species is similar to *C. calcitrapa* and specimens identified as *C. calcitrapa* may be *C. iberica*. Two such cases have been revised: Soil Conservation Col-

lection, Sept. 10, 1955, Converse Co., Wyo. — DAO; *Jones s.n.*, July 13, 1946, Labette Co., Kans. — DAO). To our knowledge, *C. iberica* has not been reported in Kansas or Wyoming. Iberian Star-thistle may occur in states other than California, in ranges reported for *C. calcitrapa*.

7. *C. muricata* L. (*Amberboa muricata* (L.) DC., *Voluntarella muricata* (L.) Benth. & Hook.); rare: U. S. — Santa Barbara, Cal.

8. *C. salmantica* L. (*Microlonchus salmanticus* (L.) DC., *Mantisalea salmantica* (L.) Briq. & Cavill.); rare: U. S. — Cal. (Howell, 1959), Ariz., (Kearney & Peebles, 1960)

9. *C. diluta* Ait. Rare: U. S. — Cal.

10. *C. maculosa* Lam. Spotted Knapweed, Centaurée; common: U. S. — all states except possibly the southeastern; Canada — N. S., N. B., Que., Ont., B. C. The plant is a serious weed in some areas, forming infestations.

This taxon is treated in many different ways by European authors. Some take up the prior name *C. stoebe* L., which may or may not apply. Others treat *maculosa* as a variety of *C. paniculata* or divide *maculosa* into three subspecies, which by other authors, are raised to species.

Among North American collections the ssp. *micranthos* (Gmel.) Gugler is distinguished by smaller heads (involucre 10-11 mm high) and fewer (4-6 pairs) and shorter phyllary processes and by the black or brown pigmentation of the phyllary margin and processes, contrasting with the green blade. The ssp. *rhenana* (Bor.) Gugler and ssp. *maculosa* have larger heads (involucre 11-14 mm) and 5-10 pairs of longer marginal processes which are black — dark brown in *rhenana* but brown and partially white in the typical subspecies.

11. *C. paniculata* L. Rare: Canada Vancouver Is., B. C.

This species is similar to *C. maculosa* and there has been dispute whether these B. C. plants are *paniculata* or *maculosa*. Howell (1959) has restored *C. paniculata* to the B. C. Flora and his decision seems to be justified.

12. *C. diffusa* Lam. Tumble Knapweed; common: U. S. — apparently widespread in the north, above 40°, probably common in western states and occasional elsewhere; Canada — Alta., B. C.

13. *C. virgata* Lam. var. *squarrosa* (Willd.) Boiss. (*C. squarrosa* Willd.); rare: U. S. — Cal., Utah (Howell, 1959).

14. *C. jacea* L. Brown Knapweed; common: U. S. — widely reported for northeastern and west coast states, probably midwest also; Canada — Que., Ont., B. C.

Specimens of *C. pratensis (nigra × jacea)* are frequently identified as *C. jacea*. Probably both of these occur within the range commonly stated for *C. jacea*. Phyllary appendages are brown, chartaceous and entire or subentire but not deeply lacerate as in the hybrids. Heads are radiate.

15. *C. nervosa* Willd.

Not known to occur in Canada or U. S. This species has been reported only by Fernald (1950) from one collection (*Burnham*, July 30, 1916, margin of grainfield, east of lower falls, N. Beaver Creek, Vaughns, north of Hudson Falls, Washington Co., N. Y. — GH!). We have revised this specimen to *C. austriaca*.

Plants of *C. nervosa* are 10-40 cm tall, usually unbranched, with a single head, the stem leafy to the top; lower leaves oblanceolate, base tapering, middle and upper leaves oblong, base truncate or shallowly clasping; involucre 20-24 mm high; phyllaries lanceolate to 2 cm long, recurved, plumose, black or dark brown.

16. *C. austriaca Willd.* (*C. phrygia* ssp. *austriaca* (Willd.) Gugler); rare: U. S. — N. Y., Vt., O.

This species has been reported only by Seymour (1969) on the basis of a collection from Dorset, Bennington Co., Vt. (*Gilbert s.n.*, Sept. 22, 1966 — VT!). We agree with this identification. This collection and that of Burnham (see *C. nervosa*) are from adjacent counties of New York and Vermont, from locations approximately 25 miles apart. Gilbert notes that the plants had persisted near farm buildings for several years but did not seem to mature seed. However, it seems that the introduction has survived for half a century in this area. An additional collection, probably this species, from Ohio (*Webb* 1525, Sept. 18, 1921, Portage Co., O. — GH!) has been seen.

These plants are 15-80 cm tall, branched and bearing many heads per plant; cauline leaves narrow, upper leaves not clasping the stem; heads smaller than in *C. nervosa*, ovate, approximately 14 × 16 mm; inner phyllaries rounded at tip, middle and outer phyllaries long and plumose, black or dark brown, recurved.

17. *C. nigra* L. Black Knapweed, Centaurée noire; (*C. jacea* var. *nigra* Briq., *C. consimilis* sensu Piper & Beattie, Flora Southeastern Washington, 1914); common: U. S. — widespread in the northern states, probably south to about 37° N; Canada — Nfld., P.E.I., N. S., N. B., Que., Ont., B. C.

The type specimen of *C. nigra* has eradiate heads (Marsden-Jones & Turrill, 1954) and it seems that plants that are typical in other characters as well are always eradiate. Descriptions and illustrations in some floras indicate that *C. nigra* may have radiate or eradiate heads. The radiate plants are, in our opinion, *C.* × *pratensis*, a hybrid between *jacea* and *nigra* which is highly variable and sometimes closely approaches the parental species.

In typical *C. nigra* the phyllary appendages are

black (not dark brown), the wiry cilia very long, almost matted, covering adjacent phyllaries. A white-flowered form (*C. nigra* f. *pallens* Spenn) has been collected in N. S. and Que., Canada.

18. *C.* × *pratensis* Thuill. Protean Knapweed; common: U. S. — probably throughout the ranges reported for *C. nigra* and *C. jacea* (northern states); Canada — N. S., Que., Ont., B. C.

This is a hybrid between *C. nigra* and *C. jacea* and is apparently included in the description of *C. nigra* in some floras. Abrams & Ferris (1960) and Howell (1959) report the occurrence of the species on the west coast of U.S.A. Specimens from Mass., Me., N. Y., Pa., R. I., Vt., (GH, VT) have been examined in this study.

This hybrid shows great variation in the form of the phyllary appendage: wiry and pectinate, dark brown but not black, cilia long and covering adjacent phyllaries; some appendages pectinate and others partly pectinate and partly chartaceous-lacerate and showing many intermediate conditions between pectinate (*nigra* character) and chartaceous (*jacea* character); sometimes all chartaceous and subentire. Thus the appendage form may closely approach those of the typical parent species but usually shows some evidence of an intermediate condition. Heads are usually radiate but may be eradiate in specimens which closely approach *C. nigra*.

19. *C. nigrescens* Willd. Short-fringed Knapweed; (*C. vochinensis* Bernh., *C. transalpina* Schleicher p.p.); common: U. S. — probably widespread in the northern states; Canada — N. S., Que., Ont., B. C.

Kerner (1881, pp. 81-85) selected the type of *C. nigrescens* in Willdenow's herbarium and found it to be the same as the later-described *C. vochinensis*. Many U. S. floras recognize *C. vochinensis*, some take up *C. nigrescens* and a few list both species. Appar-

ently *C. dubia* is included. There is confusion in the application of these names. Collections of *C. nigrescens* from Conn., D.C., Ind., Mo., N. J., N. Y., Neb., Ore., Pa., Va., Wisc., (DAO, GH, NY) and from the above-listed provinces of Canada have been seen.

The heads separate *C. nigrescens* from the generally similar *C. nigra*. The involucre of *C. nigrescens* is longer than broad and the small, triangular, black, short-fringed appendages contrast strongly with the green phyllary blades which are not covered by the appendages. The upper (branch) leaves tend to be noticeably smaller than the lower leaves. Heads of this species and of *C. dubia* are usually eradiate.

20. *C. dubia* Suter (*C. nigrescens* Willd. *p.p.*, *C. transalpina* Schleicher *s. str.*, *C. jacea* var. *transalpina* Briq., *C. dubia* ssp. *eu-dubia* (Suter) Gugler & Thellung, *C. nigrescens* var. *dubia* Hermann); common: U. S. — Mass., N. J., N. Y., O., Ore., Va., Vt.

According to Cronquist (1955; Gleason & Cronquist, 1963) who is the only author to recognize *C. dubia* in North America, the species is widely established in northeastern United States and southeastern Canada and occasional in northwestern U.S.A. We have seen specimens (NY, GH) from the above states; none from Canada are known. The species is closely related to *C. nigrescens* and it is difficult to separate some specimens.

These plants are similar to *C. nigrescens* but the phyllary appendages have longer cilia which almost, and sometimes completely, cover the adjacent phyllary bases. There is no distinct difference in size between upper and lower leaves and the latter may tend to be broader.

21. *C. macrocephala* Puschk. in Willd. Rare: Canada — Que., a casual adventive from cultivation, probably not persisting (Moore & Frankton, 1972).

22. *C. rothrockii* Greenm. Native species: U. S.: — sw N. M., se Ariz.

23. *C. americana* Nutt. Native species: U. S. — Ark. & Ia. to Ariz., occasionally an escape from cultivation in the northeast.

24. *C. repens* L. Russian Knapweed; (*C. picris* Pall., *Acroptilon repens* (L.) DC., *A. picris* (Pall.) Boiss.); common: U. S. — reported in all states except the southeastern; Canada — Ont., Man., Sask., Alta., B. C.

This species is frequently a serious weed in our area. There is cytological and morphological justification for segregating this species as *Acroptilon repens.*

25. *C. moschata* L. Sweet Sultan; (*Amberboa moschata* (L.) DC.); rare: U. S. — northeast, Ill., Cal.; Canada — Vancouver Is., B. C.

This garden escape seems to persist in the northern states but is never common.

26. *C. montana* L. Mountain Bluet; rare: Canada — Nfld., N. B., Que., Ont., B. C.

Gleason & Cronquist (1963) state that this species is a rare escape in the northern part of the range of their flora (northeastern states and adjacent Canada).

27. *C. cyanus* L. Bluebottle, Cornflower, Barbeau, Casse lunette; (*Leucacantha cyanus* Nwd. & Lunnel, *Cyanus segetum* Bauh.); common: U. S. — probably all states: Canada — all provinces except Sask.

This garden escape is reported in all regions. The variety *denudata* Suksdorf, reported for Wash., is a less pubescent variant.

28. *C. cineraria* L. Dusty Miller; rare: U. S. — Cal.

29. *C. scabiosa* L. Greater Centaurea, Hardheads, Centaurée scabieuse; rare: U. S. — O., Ia., Mont., Canada — Que., s. Ont.

This escape is apparently not widely established; it

is mentioned for only three states by several floras. The reported occurrence in N. B., Canada (Boivin, 1966-67) is an error due to a mislabelled specimen (Boivin, personal comm.).

SUMMARY

Twenty-six introduced and two native species of *Centaurea* are known to occur in the area Canada-United States. Sixteen of the adventive species are found in Canada and three of these in Canada alone. An additional ten introduced and two native species occur in the United States, making a total of 23 introduced and two native species in that country.

Probably eleven of the introduced species can be classed as widespread: *C. solstitialis, C. calcitrapa, C. maculosa, C. diffusa, C. jacea, C. nigra, C. × pratensis, C. repens, C. cyanus* and perhaps *C. nigrescens* and *C. dubia*. With the exception of the last, these species are known from both countries and generally the ranges are continuous, although more extensive in the United States. A number of the rarer species are known only in the southwestern states, notably California.

Five species (*C. diffusa, C. jacea, C. maculosa, C. nigra, C. repens*) are regarded as weeds in Canada (Frankton & Mulligan, 1970), *C. repens* being the most serious. Russian Knapweed has been reported to cause sheep and horse poisoning in the Old World and *C. repens* and *C. solstitialis* have recently been shown (Young, Brown & Klinger, 1970) to cause Chewing Disease in horses in the western United States.

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A NEW VARIETY OF LEUCOPHYLLUM LAEVIGATUM (SCROPHULARIACEAE) FROM MEXICO

Robert W. Kiger

In the course of field work in northern Mexico during the summer of 1971, we (J. L. Reveal, W. J. Hess and the author) collected *Leucophyllum laevigatum* Standl. from the Carneros Pass area of Coahuila. Our collection differs in several respects from the typical phase of the species as it is found in San Luís Potosí, Durango and Chihuahua. Aside from ours, the only other collection from Coahuila, based on a study of specimens at the National Museum of Natural History at the Smithsonian Institution and the herbarium of the Field Museum, is one made by Pringle in the same area in 1890. It also differs from the typical phase and resembles our collection closely. In view of the morphological differences found in the Coahuila specimens, their geographical separation from the rest of the known range of the species, and the evidence that the same geographical and morphological correlation has existed over at least the past 80 years, a new variety of *L. laevigatum* is here proposed. This is the first intraspecific taxon to be described for the species, itself first described in 1924.

Leucophyllum laevigatum Standl.
var. **coahuilense** Kiger, var. nov.

A var. *laevigato* foliis plerumque late oblanceolato-spathulatis, ad 16 mm longis ac 8 mm latis, frequente ac profunde emarginatis, nunquam acutis, saltem subtus persistenter stellato-tomentulosis, sepalis lineari-lanceolatis, corolla caerulea, 2-2.5 cm longa, tubo latius campanulato diagnoscenda.

Low spreading shrub, the young branches densely white stellate-tomentulose with the pubescence thinning with age; leaves mostly broadly spatulate-oblanceolate, to 16 mm long and 8 mm wide, the apex rounded or more frequently markedly emarginate, never acute, often mucronulate, the

young petioles densely stellate-tomentulose, the leaf-blades sparsely stellate-puberulent above and moderately so below when young, the pubescence persistent at least below; pedicels 3-5 mm long, stellate-tomentulose; calyx cleft nearly to base, the sepals linear-lanceolate, to 4 mm long, acute, stellate-tomentulose outside, often glandular within and without; corolla blue, yellowish mottled low in tube, 2-2.5 cm long, campanulate, glabrous and semi-lustrous outside, the tube to 13 mm long, moderately to sparsely arachnose-pubescent inside, the limb unequally 5-lobed, the lobes obovate, the 3 larger broadly so, rounded at the apex, moderately villous-sericeous within, the margin cilate, the stamens didynamous, the filaments adnate to the corolla tube for 1/2 their length, to 7 mm and 8 mm long respectively, the stigma included in the corolla throat at anthesis about 1 mm below the mouth; mature capsules to 5 mm long.

TYPE. MEXICO: Coahuila: Carneros Pass area, along Mexico Highway 54, 0.7 mile west of highway, about 0.5 mile south of Estación Carneros, 23 miles south of Saltillo, in low canyon associated with *Yucca, Agave, Opuntia* and *Juniperus*, 5 August 1971, *Reveal, Hess & Kiger* 2617. Holotype US! Isotypes to be distributed from US.

ADDITIONAL SPECIMENS EXAMINED. MEXICO: Coahuila: Carneros Pass area, *Pringle* 3460 (F, US).

The typical variety of *Leucophyllum laevigatum* has leaves proportionately more narrowly spatulate-oblanceolate, to 20 mm long and 6 mm wide, more often rounded and less frequently and deeply emarginate, sometimes acute, and becoming glabrous or at least glabrate with age. The sepals are linear and usually 2-3 mm long, rarely reaching 4 mm in length. The most striking differences between the two varieties are associated with the corolla. In the typical variety, as in other species of *Leucophyllum* in Mexico, the corolla is purple to violet, whereas in var. *coahuilense* it is a definite blue. In the latter the corolla is consistently from 2 to 2.5 cm long at anthesis, most often

closer to 2.5 cm, while in var. *laevigatum* it is from 1.3 to 2 cm long, usually about 1.5 cm. The tube is proportionately longer in var. *coahuilense* and is more broadly campanulate than in the typical variety where it is narrowly so. Though capsules as long as those usually found in var. *laevigatum* (to 6 mm) have not been observed in the new variety, the difference is probably not significant since the specimens of the latter have only a few mature capsules. Too, while the capsules of the typical variety reach 6 mm in length, they are often smaller and thus overlap the range observed for var. *coahuilense.*

The type of *Leucophyllum laevigatum* var. *laevigatum* was collected by Nelson (4689) in Durango, Mexico, between Ramos and Indé (holotype, US!). Other specimens of this variety examined include — MEXICO: San Luís Potosí: Charcas, *Lundell* 5512. Durango: Huarichic, northeast of Pedricena, *Pennell* 18604; Indé, *Reko* 5207; 5 miles northeast of Yerbanis, *Moran* 6248; 10 miles north-northwest of Rodeo, *Morley* 630; 20 miles south of Zarca, *Gentry* 8614. Chihuahua: near La Boquilla, *Shreve* 8072. All specimens examined are at US.

Field studies in Mexico were supported by an NSF grant, GB-22645, to James L. Reveal for studies on the genus *Eriogonum* and the Intermountain Flora.

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VARIATION WITHIN CALOCHORTUS VENUSTULUS (LILIACEAE)

JAMES L. REVEAL AND WILLIAM J. HESS

While collecting specimens of a new *Eriogonum* in the high mountains west of Hidalgo del Parral of northern Mexico, we made small collections of routine nature in order to better understand the local vegetation. In addition to the new *Eriogonum,* we found an unknown *Castilleja* which Dr. Noel Holmgren of the New York Botanical Garden will describe and a variant of *Calochortus venustulus* Greene which likewise is undescribed.

Calochortus venustulus Greene var. **imbricus** Reveal & Hess, var. nov. A var. *venustulo* petalis 20-28 mm longis, pedunculis 10-15 cm longis, plantis 3-4.5(6) dm altis differt. Stems 3-4.5(6) dm high; peduncles erect, slender, 10-15 cm long; petals obovate, 2-2.8 cm long.

TYPE. MEXICO: Durango: Sierra Madre Occidental, along the dirt road from Hidalgo del Parral toward El Vergel out of San Francisco del Oro, about 60 road miles west of Parral and 18.5 road miles west of Ojito, on forest floor and slopes near limestone outcrops, associated with *Quercus reticulata, Pinus ponderosa* and *P. leiophylla, Arctostaphylos, Arbutus* and numerous other low shrubs and herbs, at about 8000 feet elevation, 11 August 1971, *Reveal, Hess & Kiger* 2741. Holotype, US! Isotypes to be distributed from US.

The var. *imbricus* (from the Latin *imbricus,* rainy, alluding to the rainy day that we discovered this plant) is a lovely addition to a genus already well noted for its beautiful members. Particularly, in the darkness of the rain and heavy clouds on that day, its large, golden flowers stood out in marked contrast from the dark greens and browns of the pine-oak forest floor.

During our investigations of this taxon, we found that *Calochortus venustulus,* as defined by Ownbey (1940), should be further subdivided.

The typical variety, var. *venustulus,* is common in the Sierra Madre Occidental west of Durango where it occurs

in the forests and dry meadows. However, to the north, west of Chihuahua and hence northward nearly to the United States, a second element is common in open plains and scattered oak forests. This phase was named *C. madrensis* by Watson just a few months after Greene proposed *C. venustulus* and has been placed in synonymy under the latter name. However, the northern population is consistently taller, with longer peduncles and shorter leaves in relationship to the inflorescence. This pattern of distribution is somewhat similar to that found in *Eriogonum atrorubens* Engelm. in Wisliz. (Reveal, 1967), and likely is expressed by other species as well. Thus, we feel the northern element should be recognized as *C. venustulus* var. **madrensis** (S. Wats.) Reveal & Hess, based on *C. madrensis* S. Wats., Proc. Amer. Acad. Arts **23**: 283. 1888.

These variants may be distinguished as follows:

A. Petals (10) 12-16 (18) mm long. (B)
  B. Plants 1-2 dm high; leaves mostly longer than the inflorescence; peduncles 3-6 cm long; Durango . . . var. *venustulus*
  B. Plants (1.5) 2.5-4.5 dm high; leaves mostly as long to slightly shorter than the inflorescence; peduncles 5-8 cm long; Chihuahua . . . var. *madrensis*
A. Petals 20-28 mm long; plants 3-4.5 (6) dm high; leaves mostly shorter than the inflorescence; peduncles 10-15 cm long; extreme northern Durango . . var. *imbricus*

Field studies in Mexico were supported by an NSF grant, GB-22645 to Reveal for studies on the genus *Eriogonum* and the Intermountain Flora.

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NEW FORM OF THUJA OCCIDENTALIS RESEMBLING KNOWN CULTIVARS

MARY I. MOORE

In 1963 the author visited the canyon of the Barron River in Algonquin Provincial Park, Ontario at latitude 45°54′ N and longitude 77°38′-39′ W. Normal *Thuja occidentalis* L. grows on slopes at the foot of cliffs in this mile long fault in granitic gneiss. On several talus formations there are dwarf forms, barely a meter high, with dead tops, compact, prostrate branching and normal leaf development. One dwarf shrub of very unusual form was found (Moore, 1964) on a north facing rock slide covered with a carpet of chasmophytic ferns, *Cladonia* and bryophytes such as *Hedwigia* and *Polytrichum*. A specimen was sent to the Plant Research Institute, Dept. of Agriculture, Ottawa. Drs. W. G. Dore and C. Frankton were unfamiliar with the shrub but established the anatomy of the stem as that of a conifer and the odor as that of Eastern white cedar (Frankton in litt., 1963). In 1968 Dr. R. E. Beschel, Queen's University, Kingston, Ont. visited the shrub and noted its resemblance to certain bizarre cultivars. Both he and Mr. E. Perem of the Wood Anatomy Group, Eastern Forest Products Laboratory, Ottawa considered that the wood anatomy corresponded with the description given for *T. occidentalis* (Arbor vitae).

DESCRIPTION

The shrub has a central stem 0.8 m high, with eight branches up to 2 m in length on the lower half. Of these, two come from beneath the rock and are in a prostrate position. The branches may have three orders of branching and bear live or dead leaves. They are basically of three types:

(1) About 75% are whip-like, sparingly ramified, with four rows of equal, appressed-decussate, ovate, keeled and pointed leaves 3-5 mm long (Fig. 1; 2A, 2B. Fig. 2A). The overall tetragonal habit of the branches resembles strongly some appressed species of *Cassiope* D. Don.

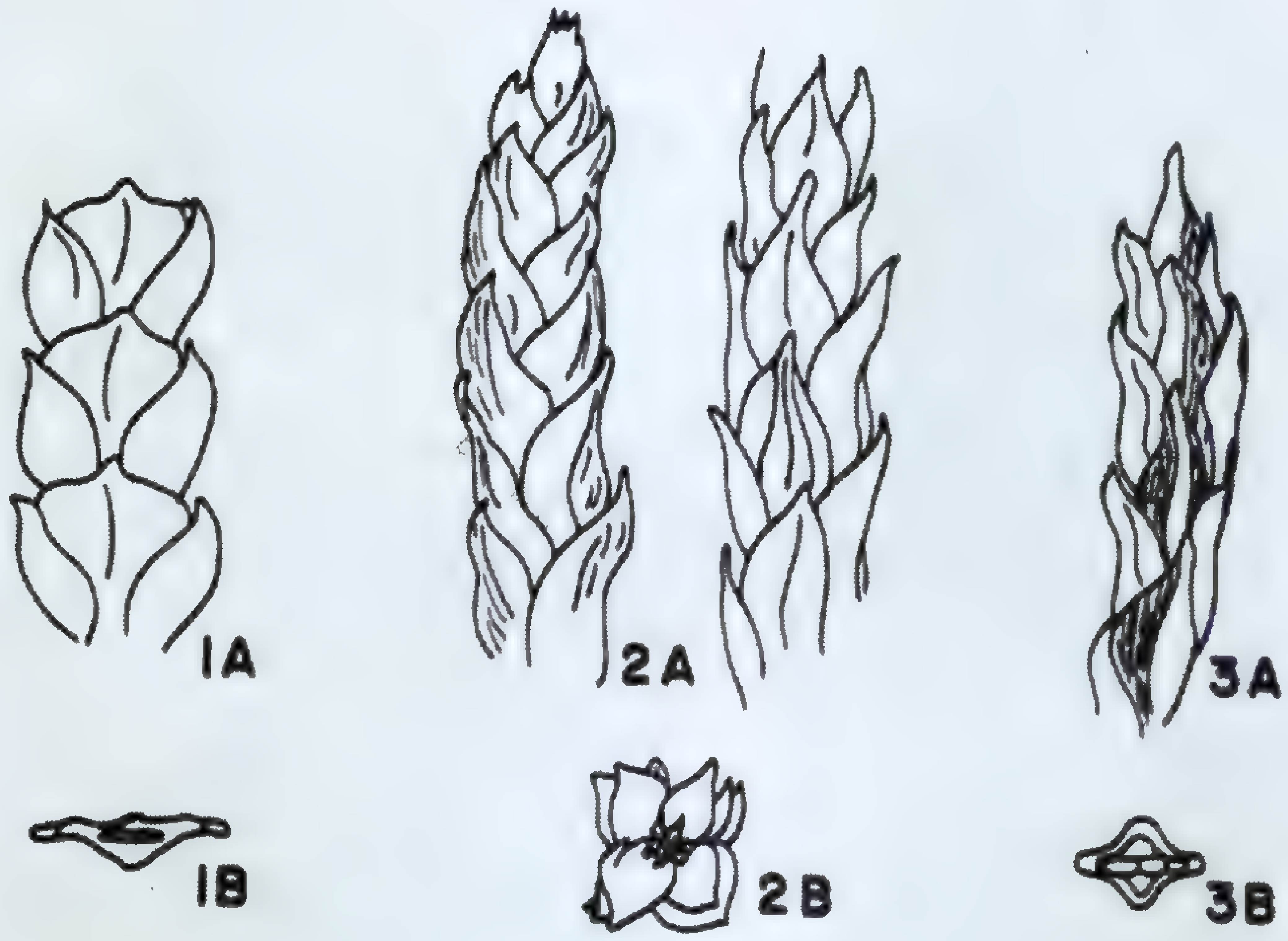

Figure 1. Branch and leaf form of typical *Thuja occidentalis* and the dwarf conifer in the Barron canyon. A — side view of branchlet, B — end view of branchlet: 1 — typical *T. occidentalis,* 2 — tetragonal, decussate form on dwarf conifer, 3 — lycopodiaceous form on dwarf conifer.

(2) Several branches bear fastigiate clusters of twigs with rows of divaricate, needle-shaped leaves 6-8 mm long. These appear juvenile but some are stiffer and more sharply pointed. They may develop in a gradual sequence out of the first type and revert again to it (Fig. 2B).

(3) A few small sprays bear leaves similar to but usually smaller than (1). These branchlets are flattened, without the constricted segments of normal *T. occidentalis,* and are intensely branched in the manner of *Lycopodium tristachyum* Pursh (Fig. 1; 3A, 3B. Fig. 2C).

DISCUSSION

The shrub bears no external resemblance to a normal *Thuja occidentalis.* A search of botanical and horticul-

Figure 2. Branches from dwarf conifer in Barron canyon. A — tetragonal, whip-like branch, sparingly ramified, B — fastigiate cluster with juvenile-type needles, C — lycopodiaceous form of branching.

tural literature reveals no such specific entity. The forma *prostrata* of Vict. & Rousseau has normal adult leaf structure and differs mainly in habit. Var. *ericoides* Beiss. & Hochst., which is also a cultivar, bears only small resemblance to parts of the shrub with juvenile-type needles. The cultivar, *'Douglasii'* Rehder, given as a synonym for *'Filiformis'* Beiss., has some similarity with it and is described as a compact shrub with slender, pendulous branches often flattened at the tip. Bailey (1923) says these branches are partly four-angled with sharply pointed leaves, but his illustration shows very typical *T. occidentalis* foliage. Rehder (1901), the authority for the variety, states that the stronger shoots are round, covered with widely-spaced, long, pointed and somewhat projecting leaves, but that there is

no juvenile foliage. The illustration of Welch (1966) confirms this. *'Ohlendorfii'* has tetragonal branches with decussate leaves but the illustration in Welch shows a very compact shrub with upright branches.

The leaves of the tetragonal and lycopodiaceous branches do show an interesting resemblance to those of *T. orientalis* L., species of *Cupressus* and *Chamaecyparis* (Dallimore & Jackson, 1948) as well as to forms of *Juniperus*.

Horticultural forms of dwarf and other abnormal conifers are developed by mutation, self-pollination and hybridization. According to Welch most, if not all, cultivars of Arbor-vitae were originally the result of seed mutation. Such seedlings can be cultivated in a nursery, but in nature their chances of survival are not great. *'Spaethi'* (Anonymous, 1893), a synonym of *'Ohlendorfii'*, was developed in this way from a seedling of *T. occidentalis*.

CONCLUSION

The question has been asked, is the shrub a monstrosity induced by the particular habitat in which it occurs, or is it a genetic form that arose as a result of self-fertilization, hybridization or mutation.

The shrub is close to the river where in some years it could be subject to damage from ice and high water; a visit in 1970 showed that this had recently occurred with damage to many of the long, tetragonal branches. The climate of the canyon is, in part, abnormally cool; several rare arctic-alpine species occur there (Moore, 1964) and on the first visit in late May two large ice falls were still present. The lower branches of cedars along the river are browsed. However, no other known cedars have abnormal leaves.

Abnormal leaf forms may appear on young conifers, usually under thirty years of age, after which they usually outgrow all or most of the characteristics (A. R. Buckley, Horticulture Division, Plant Research Institute, pers. comm., 1969). The shrub in question must be at least fifty

years old since Mr. Perem gave the age of a small branchlet 2.3 mm in diameter as more than twenty years.

The plant presumably could not have been a hybrid because no other species of *Thuja* grows naturally in Ontario. The canyon could not have been cultivated and what farms may have been in this area of the precambrian shield have returned to forest. It could have been due to self-pollination. However, it seems most probable that the shrub is the result of a spontaneous mutation. Unfortunately there is no evidence of flowering or cone development.

Mr. John Santon, Petawawa Forest Experiment Station, has rooted tiny cuttings of both juvenile and tetragonal foliage. Growth the first winter was generally of the tetragonal, decussate form common to the shrub but present summer growth is mostly of the juvenile type. Mr. Santon considers that this alteration of form may be seasonal but commented that a return to juvenile growth is frequent in cuttings.

The dwarf conifer in the Barron canyon appears to be a unique form. Its wood anatomy defines the shrub as *Thuja occidentalis* and the odor is characteristic of that species. It can be assumed that this Eastern white cedar was not induced by humans although the shrub does resemble in part several bizarre cultivars of the species previously described.

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SNOW COVER AND THE DIAPENSIA LAPPONICA HABITAT IN THE WHITE MOUNTAINS, NEW HAMPSHIRE[1]

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The alpine zones of the White Mountains, New Hampshire, provide a convenient study area for investigators interested in the ecology of alpine plants. The White Mountains are a series of peaks, heavily glaciated during the Pleistocene Epoch, 46 of which exceed 4,000 ft. The highest of these is Mt. Washington (6,288 ft.) in the Presidential Range. During the Wisconsin substage of Pleistocene glaciation the climate allowed arctic plants to become established in the area. The present harsh climate typical of the alpine zones of the White Mountains has maintained these plants as an arctic outpost in a temperate area. Treeline, here defined as the upper limit of continuous tree cover, is located at about 4,800 ft. on the west side of the Presidential Range and at about 5,200 ft. on the east (Antevs, 1932; Bliss, 1963). Prevailing winds are from the west. The best developed alpine zone in the White Mountains is found on the Presidential Range; it extends from Mt. Madison (5,363 ft.) in the north to Mt. Clinton (4,312 ft.) in the south. The area is about eight miles long and two miles wide at its greatest extent and encompasses about 7.5 square miles (Bliss, 1963). A smaller alpine zone exists in the Franconia Range some 20 miles west of the Presidential Range; it extends from Mt. North Lafayette (5,000 ft.) to Mt. Haystack (4,600 ft.), having as its highest point Mt. Lafayette (5,249 ft.). This zone encompasses about 1.5 square miles.

The climate of the alpine zone has been summarized by several investigators (Antevs, 1932; Bliss, 1963; Pease, 1964). Weather information has been gathered by the Mt.

[1]This paper constitutes a part of a doctoral dissertation submitted to the University of New Hampshire.

Washington Observatory located on the summit of that peak. In general, the climate is characterized by high winds, low temperatures, high precipitation with heavy winter snow and extensive fog and cloud cover.

This paper represents a portion of a larger investigation involving the distribution of White Mountain plants relative to winter snow cover. The purpose of the present study is to define the ecological relationship between snow cover and a habitat typified by *Diapensia lapponica* L., an Angiosperm cushion-forming plant, used by Bliss (1963) to characterize the association he termed the "*Diapensia* community".

In both the arctic and in the alpine zones of the White Mountains *Diapensia* is reported in exposed and windswept areas (Antevs, 1932; Hadley and Bliss, 1964; Löve and Löve, 1966; Courtin, 1968, 1968a). Several investigators have further suggested that the plant is limited to areas blown clear of winter snow (Hadley and Bliss, 1964; Courtin, 1968, 1968a). Bliss (1963) reports that *Diapensia lapponica* is a prime colonizer of bare ground and is found in ". . . areas that are subjected to frost action because of the lack of winter snow cover". Later, (1966) he reports, "*Diapensia* communities are found where winter snow cover is thin, or non-existent, and melts early in spring". Bliss (1969) recorded snow depth for two winters in three locations; it is not stated if any of these locations were in *Diapensia* areas. However, he states, "During much of the winter, large areas of Alpine Garden are blown free of snow, areas dominated by *Diapensia* communities".

My objective in this study was to analyze the species composition of the *Diapensia* habitat and to determine the degree of interdependence among its component species. First, it was necessary to test the snow cover hypothesis described above by gathering extensive records of winter snow depths in *Diapensia* habitats. I observed a number of habitats over several seasons to find if the plants did inhabit snow-free areas and if these areas were substantially free of snow throughout the winter season. A

system of summer sampling was designed to accumulate data for statistical analysis of interdependence among component species of the habitat.

Snow Depth and Winter Dessication

For the winter snow depth study 14 plots were established and marked with wire stakes at the margins of the greatest *Diapensia* concentrations. Two plots were located in each of the following areas: near the fourth peak of Mt. Adams, at the Lake-of-the-Clouds Hut, on the summit cone of Mt. Washington, on the section of the Chandler Ridge termed Cape Horn, at the lip of Huntington Ravine in Alpine Garden, at Lion Head in Alpine Garden and at Cow Pasture on the Automobile Road. These plots were visited throughout the winters of 1966-1967, 1967-1968 and 1968-1969 on as nearly a regular basis as the harsh winter weather of the Presidential Range permitted. Each plot was visited at least once each winter and some as many as eight times. During the three winters 14 trips were made to check snow depths in plots.

After a snowfall in the White Mountains the wind frequently rises, usually from the west. Most of the snow which has accumulated during the storm in the open alpine zone is blown away and collects below treeline on the east side of the mountains. This is particularly true on the Presidential Range and leads to the massive accumulations of snow common in the large glacial valleys on the east side of the range, such as Tuckerman and Huntington Ravines. Snow remaining in the alpine zone is packed into the sparce vegetation or in the lee of large wind obstructions. In ascending the mountain increasing snow depth is encountered until treeline is reached; above treeline snow cover conforms to the microrelief of the alpine zone. In the *Diapensia* habitat there are few obstructions and virtually all the snow is blown clear throughout the winter season (Fig. 1).

A trip to check snow depth made on February 19-26, 1967, will serve as an example of the snow cover/wind

Fig. 1. Snow-free ridge crest, about one-half mile long, near Lion Head in Alpine Garden, Presidential Range, New Hampshire. The area is dominated by *Diapensia lapponica*. March 3, 1969.

relationship on the Presidential Range. On the night of February 20 a storm deposited a recorded 2.7 inches of snow at the summit of Mt. Washington. Drifts of two to three feet accumulated in the vicinity of the Weather Observatory. On the morning of February 21 the wind rose from the west and reached a sustained velocity of 60 to 70 MPH with a peak gust of 105 MPH. Virtually all the snow, including the large drifts, was removed from the summit area. On February 23-24 another storm developed and deposited a recorded 19 inches of snow at the summit. Winds rose during the evening of February 24 and reached a sustained velocity of 70 to 80 MPH. The wind persisted through February 26. Again, almost all accumulated snow was removed from the summit area. Visits to six *Diapensia* habitats on February 26, varying from 6,000 to 4,000 feet elevation, showed that all were devoid

Fig. 2. Winter aspect of a *Diapensia* habitat at Cape Horn, Chandler Ridge, Mt. Washington. Surrounding areas are covered with snow. The ice axe is about 40 inches long. Feb. 26, 1968

of snow after a total fall of 21.7 inches over the previous six days (Fig. 2).

Late wet snowfalls, although more dense than dry midwinter snows, are also blown away by strong winds and do not accumulate in the *Diapensia* habitat nor do they delay flowering. On May 26, 1967, a 12.8 inch snowfall was followed by winds of 70 MPH. Visits to several habitats on May 30 and 31 disclosed no snow in the areas. Less than three weeks later on June 18, 1967, *Diapensia* plants were in full bloom throughout the Presidential Range (Fig. 3).

Winds are not as strong where plants are actually growing on the range as they are where recorded on a 39 foot instrument tower on the summit of Mt. Washington. A wind velocity of 100 MPH on the summit is equivalent, on the average, to a speed of 30 MPH at plant level (Courtin,

Fig. 3. Plants of *Diapensia lapponica* in bloom, Cape Horn, Mt. Washington, New Hampshire. June 17, 1968. The lateral area covered by the photograph is about 18 inches long.

1968). Such wind velocities are still sufficient to remove snow from exposed areas and to promote desiccation in winter-exposed plants.

In an average winter on Mt. Washington the Weather Observatory records 221.4 inches of snow. The winter of 1966-1967 totaled 260.6 inches, the winter of 1967-1968, 211.1 inches and the record winter of 1968-1969 yielded 566.4 inches of snow. These variations in annual snowfall have little effect on the total amount of snow adhering to the ground in the alpine zone. My observations indicate that the snow holding capacity of the zone is reached early in the winter. Additional snow is blown away by strong winds. This study spanned two relatively normal snowfall years and one record year. Amounts of snow in *Diapensia* habitats and other areas checked remained constant. This minimal snow cover melts rapidly once warm weather arrives and melts at about the same time each year. Even

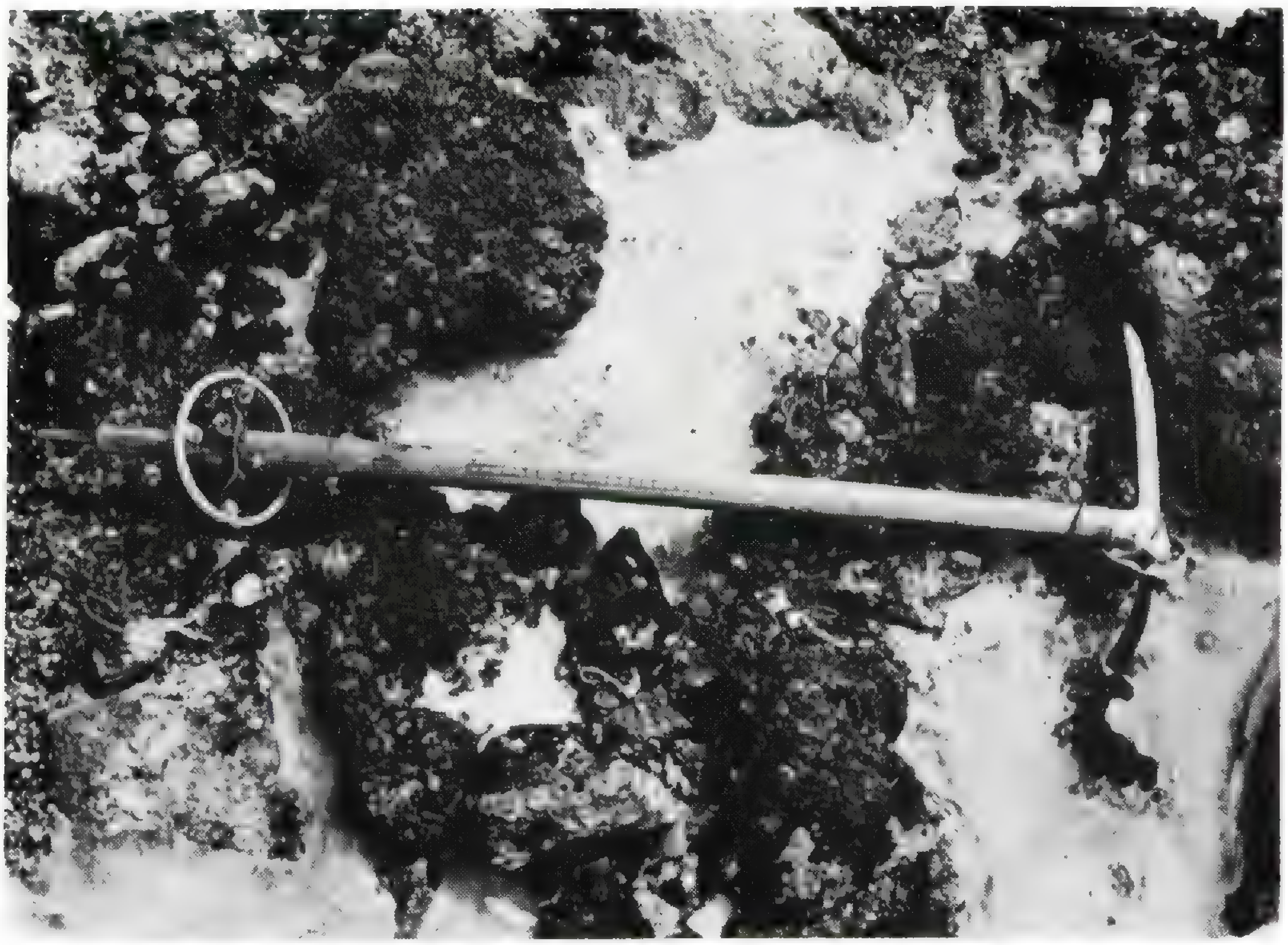

Fig. 4. Winter condition of *Diapensia lapponica* plants, Cape Horn, Chandler Ridge, Mt. Washington, New Hampshire. Meltwater has formed ice about the bases of the plants but the crowns are fully exposed. Jan. 26, 1967. The ice axe is about 40 inches long.

late-lasting drifts supporting specialized snowbank communities (Bliss, 1963) disappear at about the same time each season. The flowering time of *Diapensia lapponica* and other spring-blooming plants on the Presidential Range is not greatly influenced by heavy or light snow years or by heavy snowfalls late in May. In the three years included in this study alpine plants were at the peak of their bloom between June 15 and June 25 (Fig. 3).

The examples above, drawn from the winter of 1966-1967, are typical of results of other visits in 1967-1968 and 1968-1969. In some cases meltwater had formed ice about the bases of *Diapensia* plants but in all cases observed the major portion of the plant was exposed (Fig. 4). Areas dominated by *Diapensia* were those areas blown clear of snow throughout the winter. Accumulations of as little as a few inches of snow marked the margin of the *Diapensia*

habitat and the beginning of a transition to another form of plant cover.

Desiccation is a major factor in the distribution of alpine plants as Tranquillini (1964) notes when he states, "Extremely short snow cover can only be tolerated by plants that are resistant not only to cold but also to long periods of drought . . .", and Sakai (1970) notes that ". . . desiccation damage in winter constitutes the greatest limiting factor for growing plants in cold climates and in high mountains . . .". Plants in the *Diapensia* habitat appear well suited to resist the effects of desiccation. Several investigators have noted that the low mat or cushion form exhibited by plants such as *Diapensia* is of survival value in these conditions (Holttum, 1922; Hadley and Bliss, 1964; Courtin, 1968a). The low profile of these plants offers less resistance to strong winds and their desiccating effect is minimized.

Information on the freezing resistance of several plants of the *Diapensia* habitat has been accumulated by Sakai and Otsuka (1970). They note that several species acquire a resistance in the fall at –15° C. that allows them to withstand winter temperatures of –70° C. After acquiring such resistance *Vaccinium uliginosum* could withstand temperatures of –50° C., *V. vitis-idaea* and *Loiseleuria procumbens* could survive at –70° C. The most cold resistant plant tested was *Diapensia lapponica* which, after full hardening, could survive immersion in liquid nitrogen at –196° C. (Sakai and Otsuka, 1970). The lowest recorded temperature for Mt. Washington is –44° C. (–47° F.).

Species Composition

Twenty-two *Diapensia* habitats were chosen for sampling to determine species composition and major sample areas were located in them. Plots were placed in the center of the habitat. The sampling procedure used is similar to that of Bliss (1963). An area 4 by 8 meters (320,000 sq. cm.) was marked with surveying tape and stakes. The 4-meter axis was located parallel to the slope of the ground.

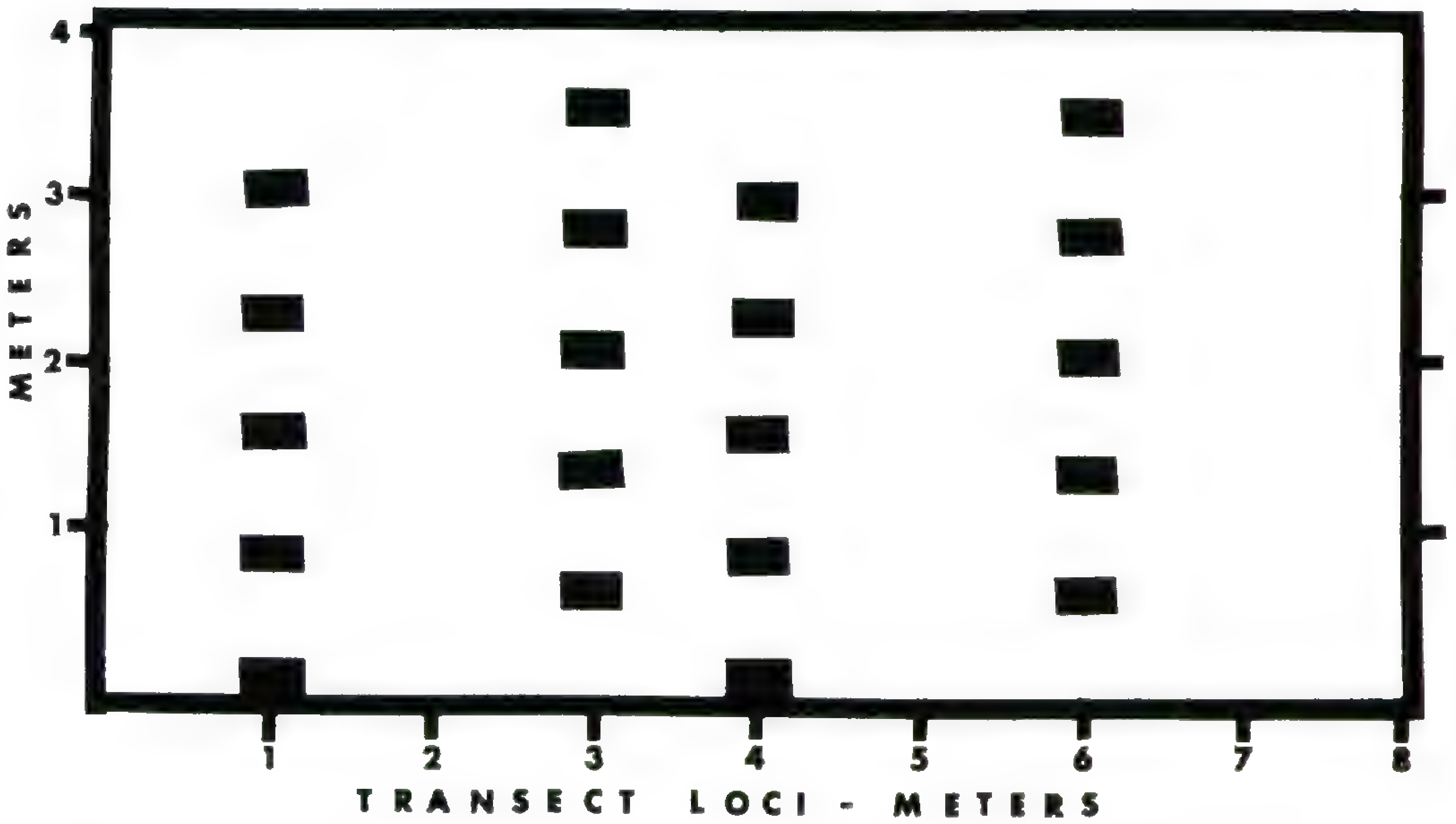

Fig. 5. Arrangement of quadrats within a major sample area. The transects on which the quadrats are located are randomly chosen. The design is similar to that of Bliss (1963).

Five rectangular quadrats 25 by 40 cm. (1,000 sq. cm.) were established along a sequence of transects based at four randomly chosen locations on the 8-meter axis. Alternate quadrat transects were begun on the 8-meter axis, and others 0.5 meters from it. Twenty rectangular quadrats were established in each major sample area for a total sampled area of 20,000 sq. cm. or 6.3% of the total area sampled (Fig. 5). Quadrat size and number corresponded with recommendations for plot size and sample design in alpine vegetation made by Eddleman et al. (1964).

Measurements were taken of the ground area covered by all vascular plants in each 25 by 40 cm. quadrat. Measurements were taken also for cover of moss and lichen and for uncolonized ground and rock. These were expressed as percent cover for each sample area, and grand totals for all 22 areas sampled were compiled. Areas sampled for species composition were, in general, the same as those used for winter observations. Results are given in Table 1.

My results expressed as percent cover are roughly comparable to those of Bliss (1963) expressed as importance

Table 1

Type	*Mean*	*Range*	*Standard Deviation*
Rock	31.1	1.4–66.6	19.5
Diapensia lapponica	27.6	1.8–54.0	15.0
Lichen (all types)	13.0	0–46.4	14.1
Vaccinium uliginosum	5.8	0–18.5	5.2
Juncus trifidus	5.3	0–23.0	6.4
Uncolonized Ground	4.3	0–18.2	4.6
Moss (all types)	3.2	0–31.1	6.7
Carex bigelowii	3.1	0–11.8	3.6
Salix uva-ursi	1.5	0–7.9	2.5
Vaccinium vitis-idaea	1.1	0–7.2	2.0
Potentilla tridentata	1.0	0–4.8	1.3
Loiseleuria procumbens	0.8	0–7.8	1.9
Rhododendron lapponicum	0.6	0–4.3	1.1
Arenaria groenlandica	0.5	0–2.5	0.7

Results of sampling major plant components of the *Diapensia* habitat, White Mountains, New Hampshire. Means, ranges and standard deviations for all types sampled are expressed as percent ground cover of the total area sampled.

Other plants were present in quantities of less than 0.5%; these minor components were not subjected to statistical analysis. These were, together with their means: *Solidago cutleri* 0.4%; *Poa alpigena* 0.3%; *Scirpus cespitosus* var. *callosus* 0.2%; *Betula* ssp. 0.1%; *Vaccinium angustifolium* 0.05%; *Abies balsamea* 0.05%; *Empetrum nigrum* 0.03%; *Prenanthes boottii* 0.01%; and *Lycopodium selago* 0.002%. These minor forms totaled 1.1% of the total area sampled. The nomenclature used is that of Fernald (1950).

values. He recorded higher values for rock and uncolonized ground as well as for *Juncus trifidus;* slightly higher values for *Potentilla tridentata, Loiseleuria procumbens, Rhododendron lapponicum,* and *Arenaria groenlandica;* similar values for *Diapensia lapponica* and *Vaccinium uliginosum,* and a lower value for lichen. Results of Bliss's analysis are based on 2 to 9 sample areas.

Results of my sampling indicate that 47.3% of the area in the *Diapensia* habitats was occupied by vascular plants, 35.4% was occupied by rock and uncolonized ground and 16.2% by moss and lichen. The typical plant of these habitats was *Diapensia lapponica* which was about five times as concentrated as the next ranking vascular plant.

Wide ranges and large standard deviations were found for all component species tested (Table 1). This suggests that it is not possible to predict with accuracy the concentrations of the components to be found in a given *Diapensia* habitat. The minimum concentration of *Diapensia lapponica,* 1.8% of the area sampled, was encountered in a plot located on the west flank of Mt. Madison. Other sample plots placed in nearby *Diapensia* habitats yielded results of 30.1%, 35.0% and 47.2% cover of *D. lapponica.* The maximum concentration encountered, 54.0% was in a plot located on the west side of Mt. Lafayette in the Franconia Range. Nearby sample plots in this area showed concentrations for *D. lapponica* of 15.6%, 22.0% and 33.4%. Values for other component species of the habitat were equally variable.

Analysis of Component Species

To assess the degree of interdependence existing among the component species of the *Diapensia* habitat statistical testing was necessary. Tests based on frequency data such as the "C_s" correlation of Hurlbert (1969) were rejected due to the difficulty of collecting accurate frequency data in alpine vegetation. As Woodin (1959) has indicated, frequency information is difficult to obtain in alpine areas of mat-form vegetation as it is hard to tell where one plant

ends and another begins. Goodall (1970) notes that, "Many plants, however, have methods of vegetative reproduction which make distinctions between individuals highly arbitrary. Biomass per unit area is a measure which is more consistently objective". For these reasons estimates of biomass in terms of percent ground cover were used here. The purpose of this part of the study is to assess the degree of interdependence present among plants of the *Diapensia* habitat. Sokal and Rohlf (1969) have said, ". . . when we wish to establish the degree of association between pairs of variables in a population sample, correlation analysis is the proper approach." Hence, the product-moment correlation coefficient has been used here.

In computing the correlation coefficient, data are ranked in two sets. The first set (Y_1) is arranged in increasing rank order, the second set (Y_2) is paired with the first. The correlation coefficient (r) indicates the degree of association between the two sets (Y_1 and Y_2) and may be expressed in percent. The value of r may vary from –1 (minus 100%) to +1 (plus 100%). A value approaching –1 indicates negative association between Y_1 and Y_2, a value approaching +1 indicates positive association between the two sets of variables. A value of r approaching 0 indicates little interdependence between Y_1 and Y_2. Reciprocal tests yield the same results. For each correlation coefficient (value of r) significance tests are performed against the hypothesis that $r = 0$.

Each of the 14 major species components of the *Diapensia* habitat (those having means greater than 0.5% of the total area sampled) was tested against the other 13 major components. This required a total of 91 correlation coefficient tests, which were performed with the aid of a computer and using Leasco Systems and Research program no. CL-00001.023-00. Results are given in Table 2.

Ninety-one tests were performed; only eight yielded positive or negative correlation coefficients of 50% or greater. The strongest relationship observed was between moss and *Arenaria groenlandica* with a value of 68.0%.

Table 2

	Rock	*Diapensia lapponica*	Lichen	*Vaccinium uliginosum*	*Juncus trifidus*	Uncolonized Ground	Moss	*Carex bigelowii*	*Salix uva-ursi*	*Vaccinium vitis-idaea*	*Potentilla tridentata*	*Loiseleuria procumbens*	*Rhododendron lapponicum*
Diapensia lapponica	–23												
Lichen	–66	–24											
Vaccinium uliginosum	–20	–56	61										
Juncus trifidus	–25	–54	33	24									
Uncolonized Ground	–27	18	–32	–24	8								
Moss	–29	–4	–13	5	–19	10							
Carex bigelowii	–7	–14	–12	–34	–7	4	25						
Salix uva-ursi	23	–2	23	12	–21	–7	–30	–34					
Vaccinium vitis idaea	–27	19	20	–15	1	2	–15	–6	–32				
Potentilla tridentata	–24	–20	12	–13	15	–9	22	45	–13	9			
Loiseleuria procumbens	10	–22	–15	7	40	39	17	–27	–15	–11	0		
Rhododendron lapponicum	–19	–7	18	–7	16	7	–15	6	0	18	–20	–23	
Arenaria groenlandica	–29	2	–24	–12	–17	54	68	61	–5	–36	27	11	0

Results of the correlation coefficient test (values of r) for each major component of the *Diapensia* habitat (those having means greater than 0.5% of total area sampled) with every other major component of the habitat. Results are expressed as percent interdependence of Y_2 with Y_1. The probability that the null hypothesis, $r = 0$, is true is .05 (5.0%) for values of r of 43% or greater.

None of the relationships tested could be considered strong (in excess of 90%).

A negative correlation coefficient resulted from the test between rock and lichen (–66%). Hence, rock and lichen covary negatively 66% of the time. Lichens sampled in this study were of the foliose and fruticose types. Crustose or rock-inhabiting forms were rare and were not included. A rock habitat is not suitable for the growth of lichens in the areas tested. With the exception of the negative relationship with lichens mentioned here, the large quantities of rock present in the *Diapensia* habitat (31.1% of the total area sampled) do not greatly influence the plants growing in the habitat.

Negative correlations resulted from tests of *Diapensia lapponica* with *Vaccinium uliginosum* (–56%) and with *Juncas trifidus* (–54%). This indicates that *D. lapponica* is negatively associated with *V. uliginosum* and *J. trifidus* about 55% of the time. The latter two plants are component species of an aggregation termed the "dwarf-shrub-rush-heath community" by Bliss (1963). This aggregation is commonly found at the margins of the *Diapensia* habitat. As these margins are reached snow cover increases slightly and *V. uliginosum* and *J. trifidus* begin to dominate. These two species also characterize areas of slightly greater snow cover, as in the lee of small obstructions dispersed throughout the *Diapensia* habitat itself. A gradient was established by Bliss (1963) with *Diapensia* at the snow-free extreme and the snowbank community at the other extreme. "Dwarf-shrub-rush-heath" is placed next in order with increasing snow cover to the *Diapensia* aggregation on this model. Rather than indicating that competitive exclusion is operating among *D. lapponica* and *V. uliginosum* and *J. trifidus,* I conclude that the negative correlations indicate that the margin of the *Diapensia* habitat has been reached in these sample situations and that a change to dominance by other forms is occurring. In this case the optimum snow cover situation for *Diapensia* has

been exceeded, and the optimum for the other two species is being approached.

This situation poses some possibilities for future experimental work. Snow depth in selected *Diapensia* habitats could be increased artificially by erecting several windbreaks in the habitat. Vegetation could be mapped prior to establishing windbreaks, then re-mapped in successive growing seasons. At question would be changes in the composition of plant aggregates growing in the altered habitat. A project of this nature is planned.

The test between *Vaccinium uliginosum* and lichen yielded a positive correlation of 61%. This indicates positive interdependence between *V. uliginosum* and lichen 61% of the time. Lichens, lacking roots, are not as firmly anchored as other plants and are frequently blown away by strong winds, an occurrence noted also by Antevs (1932). Most plants in the *Diapensia* habitat are mat-forming or cushion plants. An exception is *V. uliginosum* which, particularly in areas of slightly greater snow cover, adopts a more upright stature. Under these conditions *V. uliginosum* consists of a number of interwoven branches which provide anchorage for lichens. Possibly, the vascular plant provides support for lichens of several types and prevents them from being blown away by strong winds.

Positive results were obtained from tests between *Arenaria groenlandica* and uncolonized ground (54%), and moss (68%) and *Carex bigelowii* (61%).

The "sedge-meadow community" of Bliss (1963) was composed of two vascular plants, *Carex bigelowii* and *Arenaria groenlandica*. In addition to keeping snow cover records for the *Diapensia* habitat I accumulated information on winter snow depth in areas of sedge meadow on the summit cone of Mt. Washington. About one to two inches of snow accumulate in these areas, the rest being blown away. This amount is sufficient to cover the ground level meristems of *C. bigelowii*, although dead culms from the previous growing season frequently protrude from the thin snow cover. Sedge meadow occupies a similar posi-

tion on the snow cover gradient to the "dwarf-shrub-rush-heath community" of Bliss (1963). It is a marginal form to the *Diapensia* habitat, being supported by slightly increased snow depth. Again, experimental work should be performed to see if this form increases in concentration as a result of induced increases in snow cover in selected *Diapensia* habitats. *Carex bigelowii* and *A. groenlandica* are associated about 60% of the time in my samples.

There is doubt as to whether *Arenaria groenlandica* is annual or perennial (Gleason and Cronquist, 1963). The plant is described as being associated with mossy areas by Antevs (1932) and is regarded as being an early colonizer of bare ground by Antevs (1932) and by Bliss (1963). The plant is noted as growing on disturbed ground and particularly in hiking trails by Harris (1964). An annual or biennial life cycle would offer some explanation for the affinities of this plant for mossy areas and areas of open ground. In my tests it was positively associated with uncolonized ground 54% of the time and with moss 68% of the time. Open ground provides space to grow in the alpine zone otherwise occupied by perennial plants or rock. Mossy areas may promote seed germination and seedling survival due to greater water availability. Observations made in this study indicate that *A. groenlandica* is little controlled by snow cover, being distributed widely in a number of habitats which show wide variation in their amount of winter snow.

Loiseleuria procumbens is a cushion-forming plant very similar in form to *Diapensia lapponica*. It is rarely found in other than *Diapensia* habitats in the White Mountains. But, the test of *L. procumbens* with *D. lapponica* yielded a correlation coefficient of only –22% indicating that the plants were negatively associated –22% of the time. This value of r (–22%) is not significantly different from 0 at the .05 (5.0%) conference level.

Of ten vascular plants tested (Table 2) five showed association with other vascular plants. These were *Diapensia lapponica, Vaccinium uliginosum, Juncas trifidus,*

Carex bigelowii and *Arenaria groenlandica.* One of these five, *V. uliginosum* covaried with lichen and one, *A. groenlandica,* showed interdependence with moss and with uncolonized ground. One group of non-vascular plants, lichens, covaried with rock. Five vascular plants showed no interdependence with other components of the habitat. These were *Salix uva-ursi, Vaccinium vitis-idaea, Potentilla tridentata, Loiseleuria procumbens* and *Rhododendron lapponicum.* Of ninety-one potential positive or negative interactions tested only eight occurred; none of these eight could be considered intense.

Discussion

The community concept involves the ideas that there are interactions among the component plants of the community and that the species structure of the community follows some predictable pattern. As Odum (1971) has said, "Communities not only have a definite functional unity with characteristic trophic structures and patterns of energy flow but they also have compositional unity in that there is a certain probability that certain species will occur together". Both Savile (1960) and Bliss (1962) have noted that competition in severe habitats is often secondary to the effects of the physical environment. The result ". . . may be the random occurrence of plants with few distinct associations" (Bliss, 1962). Savile (1960) suggests that arctic vegetation may better be described by habitats than by associations. I have used the term habitat, here defined as the place where a plant grows, in this analysis of an area dominated by *Diapensia lapponica.*

Sakai (1970) has noted that winter desiccation is a major limiting factor to alpine plant growth. Sakai and Otsuka (1970) have shown that *Diapensia lapponica, Vaccinium uliginosum, V. vitis-idaea* and *Loiseleuria procumbens* can survive very low temperatures. I suggest that *Diapensia* and other plants associated with it can survive in this snow-free and exposed habitat because they can tolerate very low temperatures and resist desiccation from strong

winter winds. Other plants are excluded because they are not adapted to survive in this harsh physical environment. Further investigation may provide more information on such relationships in the alpine zone.

Conclusions

The occurrence of the *Diapensia* habitat is predictable in relation to winter snow cover. *Diapensia lapponica* is found in areas blown clear of snow throughout the winter season. Increasing snow cover results in increasing dominance by other forms of plants. The *Diapensia* habitat is located at one extreme of the snow cover gradient, and this study suggests that aggregations characterized by *Vaccinium uliginosum, Juncus trifidus* and *Carex bigelowii* may be next in rank with increasing snow cover.

Wide variation was found among concentrations of all species components over the 22 habitats tested. These habitats do not consist of predictable percentages of species components.

Interdependence among the species components of the *Diapensia* habitat are few. Of ninety-one potential interactions tested eight occurred at significant levels and none of these could be considered intense. Control in the habitat is primarily exercised by the harsh microclimate. Prime factors are low temperatures and high winds combining to promote severe winter desiccation in this snow-free area. Plants which are able to survive in this harsh microenvironment do so and grow here. Others are not fitted to survive in these conditions and may be excluded by the microenvironment.

The unpredictable concentrations of plants in the areas tested, together with their lack of interactions, renders the use of the term habitat more appropriate than the term community to describe the aggregate found in this location.

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NEW AND INTERESTING PLANTS FROM THE GREAT PLAINS

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As a result of field and herbarium studies, a number of new or interesting records of plants have been found for Kansas, Nebraska, South Dakota and Wyoming. A new form of *Sida spinosa* L. with white flowers that has been known in Kansas for several years is described. All specimens cited, unless indicated otherwise, are located at KANU.

Paspalum distichum L. KANSAS: NEOSHO CO.: 5 1/4 mi n Erie on US 59, edge of farm pond in water, 18 October 1970, *Holland* 2854. This represents an extension of the range of the species northward from Oklahoma.

Panicum philadelphicum Bernh. ex Trin. KANSAS: CHAUTAUQUA CO.: 2 mi se Sedan, sandy open scrub oak area, scattered to common, 2 October 1969, *McGregor* 20708. GREENWOOD CO.: 1 mi ne Fall River, sandy open oak wooded area, abundant in local area, 2 October 1969, *McGregor* 20691. This represents an extension of the range of the species northward from Oklahoma and westward from Missouri.

Andropogon intermedius R. Br. NEBRASKA: WEBSTER CO.: 2 mi s, 3 w Red Cloud, reseeded prairie, common, 11 August 1965, *McGregor* 19466. In Kansas this species is known from CLOUD CO.: 1 September 1952, *Fraser* 956, and REPUBLIC CO.: 10 September 1970, *McGregor* 23514. This species is widespread in tropical and subtropical areas of the Old World and is introduced in the United States.

Eleocharis quadrangulata (Michx.) R. & S. var. **crassior** Fern. KANSAS: BOURBON CO.: Bourbon Co. St. Lake No. 3, 1 mi e & 2 n of Hiattville, common along se side of lake, soggy area of shoreline over limestone, 7 August 1970, *Magrath & Weedon* 5750. COFFEY CO.: 6.5 mi n &

1.5 w of Westphalia, side of a large pond, muddy loam, three small clumps, 19 September 1970, *Magrath* 6250, NEOSHO CO.: 2 mi s & 2 w of St. Paul, muddy margin of pond in native meadow, 13 July 1965, *Holland* 1065.

Scirpus olneyi A. Gray. KANSAS: CHEROKEE CO.: 1.5 mi w, 0.5 s Baxter Springs, shallow water and muddy margin of pond, large colony, 17 July 1970, *Bare, Johnson* & *McGregor* 2530; 6 August 1970, *Magrath & Weedon* 5719 (duplicates determined by T. M. Koyama). This extends the range of the species northward from Texas and westward from Missouri where it is known only from Jefferson County.

Carex melanostachya M. B. ex Willd. KANSAS: DOUGLAS CO.: 0.5 mi n of Lone Star, roadside ditch, a few large colonies, 14 May 1964, *Kolstad* 1193; 25 May 1964, *Kolstad & Harms* 2150 (duplicates determined by F. J. Hermann); 24 May 1971, *Weedon* 6938. This is the first report of this species for North America. Komarov (1964) describes the habitat of this species as steppes, meadows and grassy places on saline soils, and gives its general distribution as Central Europe, the Mediterranean, Balkans, Asia Minor, Iran, Kulja, and the Caspian coast of the Caucasus.

Rumex stenophyllus Ledeb. NEBRASKA. BUFFALO CO.: 1 mi s of Elm Creek, sandy flood plain of the Platte River, 14 July 1968, *Bare, Johnson* & *McGregor* 1670. CUSTER CO.: 6.5 mi se Anselmo, prairie roadside bar ditch, in water, sandy soil, common, 20 July 1968, *Stephens* & *Brooks* 25182. DAWES CO.: 1.5 mi ne Crawford, wooded creek bank, wet sandy soil, weedy area, common, 14 July 1968, *Stephens* & *Brooks* 24637. DAWSON CO.: 2 mi s of Gothenburg, sandy flood plain of the Platte River, partially wooded, 14 July 1968, *Bare, McGregor* & *Johnson* 1594. GARDEN CO.: 1 mi s & 0.5 mi e of Lewellen, low wet prairie in the North Platte River valley, 13 July 1968, *Bare, McGregor* & *Johnson* 1443. GREELEY CO.: 10 mi w of Spalding, sandy banks of Cedar River, common, 28 Au-

gust 1967, *Bare & McGregor* 419. HARLAN CO.: 4 mi s of Alma, sandy area near lake, locally common, 30 August 1965, *McGregor* 19568. HOLT CO.: 8 mi s of O'Neill, wet roadside area, sandy soil, 13 July 1966, *Barker* 2968. HOOKER CO.: 16 mi w Mullen, low spot in sandhill prairie, moist sandy soil, several plants, all small, 27 August 1968, *Stephens* 28267. KEITH CO.: 0.5 mi s of Brule, bank of South Platte River, locally abundant, 28 August 1966, *McGregor* 20175. KIMBALL CO.: 6 mi w of Kimball, margin of lake, common in local area, 30 August 1966, *McGregor* 20269. LINCOLN CO.: 4 mi w of Sutherland, sandy banks of the Platte River, 14 July 1968, *Bare, Johnson & McGregor* 1542. SCOTTS BLUFF CO.: 0.5 mi n of Melbeta, bank of North Platte River, sandy soil with some white alkali present, 27 September 1968, *Weedon* 4776. SHERMAN CO.: 3 mi se Litchfield, bank of Beaver Creek, small colony, 2 September 1965, *McGregor* 19784. WEBSTER CO.: 4 mi w of Red Cloud, bank of the Republican River, large colony, 25 June 1953, *McGregor* 7545; 3 mi w of Red Cloud, 1 August 1964, *McGregor* 18676.

Polygonum sawatchense Small. NEBRASKA: SIOUX CO.: 6 mi nw Fort Robinson, open pine forested hillside, 24 June 1970, *McGregor* 22358. This is an extension of the range of the species southward from the Black Hills of South Dakota.

Suckleya suckleyana (Torr.) Rydb. KANSAS: CHEYENNE CO.: 0.5 mi w of St. Francis, sandy bank of river, locally common, 17 August 1971, *McGregor* 24027. HAMILTON CO.: 1 mi s of Syracuse, muddy bank of water hole, local colonies, 18 August 1971, *McGregor* 24091. KEARNY CO.: 3 mi ne Lakin, muddy shore of Lake McKinney, locally abundant, 18 August 1971, *McGregor* 24101. STAFFORD CO.: Quivira Natl. Wildlife Refuge, open areas in *Distichlis* flats, locally common, 19 August 1971, *McGregor* 24129.

Paronychia depressa Nutt. KANSAS: CHEYENNE CO.: 12 mi n St. Francis, rocky ledge, 9 June 1967, *Stephens*

11462. This is an extension of the range of the species southward from Nebraska and eastward from Colorado.

Stellaria aquatica (L.) Scopoli. KANSAS: DONIPHAN CO.: 1 mi n White Cloud, willow thicket, bank of Missouri River, several large colonies, 29 August 1970, *McGregor* 23467. This species is native to Europe. In North America it is known from Quebec and Ontario to North Carolina and Louisiana, also in British Columbia. It is not known from any of the states adjacent to Kansas.

Cerastium glomeratum Thuillier. KANSAS: CHEROKEE CO.: 6 mi e Baxter Springs, open rocky hillside, 13 April 1946, *McGregor* 2735. NEOSHO CO.: 9 mi n, 0.5 e Erie, pasture, 3 May 1965, *Holland* 876. In the central plains states this species has been reported from South Dakota, Illinois and Texas.

Draba lanceolata Royale. SOUTH DAKOTA: LAWRENCE CO.: 2 mi s, 8 w Walnut, Crooks Tower, top of peak, ca. 7180 ft, open woods, 12 August 1969, *Stephens* 35914. This is an extension eastward from the Rocky Mountains and Montana.

Alyssum desertorum Stapf. SOUTH DAKOTA: FALL RIVER CO.: 2.5 mi e, 1 s Oelrichs, flat prairie at Limestone Butte, dry rocky gravel soil, few plants, 20 May 1970, *Stephens* 38265. WYOMING: CROOK CO.: 17 mi s Sundance, open prairie hillside, dry rocky clay soil, few plants, 13 June 1970. WESTON CO.: 7 mi se Osage, flat prairie pasture, dry gravel clay soil, 12 June 1970, *Stephens* & *Brooks* 39597. This plant is known from collections in Oregon, Washington, Idaho and Montana. This is a weed introduced from the Old World, which is now spreading in North America.

Lesquerella gordonii (Gray) Wats. KANSAS: BARBER CO.: 4 mi s Sun City, gypsiferous soil, grassland, 6 May 1956, *Lathrop* 2249; 11 mi w Medicine Lodge, red soil, pasture, 2 June 1968, *Birkholz* 2241. CLARK CO.: 6 mi n Ashland, sandy soil, 28 April 1939, *Horr* E250; e of Clark Co. St.

Lake, grassland, dry sandy loam, common, 18 June 1951, *Horr* 3969. COMANCHE CO.: 4 mi se Coldwater, rocky level grassland, 28 April 1939, *Horr*, s.n.; 2 mi s of Coldwater, stationary sand dune bank, 28 May 1957, *Lathrop & McGregor* 3518. KIOWA CO.: 2 mi e, 3 n Belvidere, sandy grassland, common, 13 June 1951, *Horr & McGregor* 3808. MEADE CO.: 2 mi s, 1¼ e of Meade, overgrazed rocky pasture, common, 5 May 1957, *Horr* 4950; Meade Co. St. Park, sandy grassland, 16 June 1965, *Bare* 4. SEWARD CO.: 9 mi ne Liberal, sandy prairie, locally abundant, 27 April 1965, *McGregor* 19057. This is an extension of the range of the species northward from western Oklahoma.

Saxifraga occidentalis Wats. var. *occidentalis*. SOUTH DAKOTA: LAWRENCE CO.: 2.5 mi e, 5 n Savoy at Bridal Veil Falls, Spearfish Canyon, moist steep rocky bank, 22 June 1970, *Stephens* 40481. According to Hitchcock, *et al.* (1961), the nearest other localities are northwestern Wyoming and western Montana.

Croton capitatus Michx. NEBRASKA: SARPY CO.: 0.8 mi n & 3 w (on St. Spur N 150) & 2 s on N 50 of Louisville, loess over sandstone, dry roadside ditch, rare 27 September 1970, *Magrath* 6362. This extends the range of the species northward from Kansas.

Croton glandulosus L. var. *septentrionalis* Muell. NEBRASKA: ANTELOPE CO.: 1.4 mi nw of Clearwater on US 275, prairie roadside & railroad right-of-way, loam, extremely dry, one plant seen, 27 September 1970, *Magrath* 6390A. CASS CO.: 0.5 mi n Louisville, Louisville Park, flat area around small lake, dry sandy soil, abundant, 5 September 1970, *Stephens* 44634. These collections extend the range of the species northward from Kansas.

Croton monanthogynus Michx. NEBRASKA: ANTELOPE CO.: 1.5 mi w (on gravel rd) & 1.5 s & w (on paved rd) of Oakdale, dry roadside near oak woods, sandy loess,

scattered, 27 September 1970, *Magrath* 6381. FRANKLIN CO.: 1 mi w on N 4 & 1.5 s of Campbell, roadside ditch, dry loam, rare, 29 September 1970, *Magrath* & *Hays* 6472. PAWNEE CO.: 1 mi s, 5 e Burchard, weedy prairie pasture, dry rocky soil, 5 September 1967, *Stephens* 17523. RICHARDSON CO.: 1.4 mi e of Humboldt on N 4, roadcut & roadside ditch, rocky loam, common, 26 September 1970, *Magrath* 6335. SARPY CO.: 0.8 mi n & 3 w on St. Spur N 150 & 2 s of Louisville on N 50, loess over sandstone, roadside ditch, uncommon, 27 September 1970, *Magrath* 6363. THAYER CO.: 2 mi w of Chester on N 8, roadside ditch, loam, rare, 29 September 1970, *Magrath* 6481. WEBSTER CO.: 1.4 mi e of Webster-Franklin Co. line on N 4, disturbed area in an open prairie hay meadow, loam, rare, 29 September 1970, *Magrath* & *Hays* 6475. These collections extend the range of this species northward from Kansas.

Callitriche terrestris Raf. emend. Torr. KANSAS: MONTGOMERY CO.: 12 mi sw Independence, at Camp Wilderness, along damp draw in oak woods, 20 June 1970, *Holland* 2812c, in part. This is an extension of the range of the species westward from Missouri and northward from Oklahoma.

Anoda cristata (L.) Schlect. KANSAS: NEOSHO CO.: in South Mound, Lincoln Township, farmlot, 30 September 1970, *Holland* 2848. This species is native to South America and the southwestern United States. In the midwest, it is known to occur in Iowa and in McDonald Co., Missouri.

Sida spinosa L. f. **albiflora** Magrath, form. nov.
A forma *spinosa* differt petalis albis.
TYPE: KANSAS: DOUGLAS CO.: West campus of University of Kansas in Lawrence, growing along e edge of experimental greenhouse in loam soil, colony of 50-70 plants, 7 September 1970, *Magrath* 6147 (Holotype: KANU!). The white flowered plants were scattered in a large colony of plants that had typical yellow flowers.

This white flowered form of *S. spinosa* was first observed in this same area by Vernon Harms in 1962. Harms (1965) performed crossing studies on this taxon and concluded that the white flowered form represented a homozygous recessive condition for a single gene.

Hibiscus lasiocarpos Cav. KANSAS: BOURBON CO.: 1.5 mi e & 3 n of Hiattville, Bourbon Co. St. Lake, growing in marshy area along w side of lake, common, 25 August 1969, *Magrath* 4588; 7 August 1970, *Magrath* & *Weedon* 5746. CHEROKEE CO.: 2 mi s of Galena, in mixed woods of the flood plain woods of Shoal Creek, 5 August 1956, *Lathrop* 2863; 1 mi s of Riverton, low swampy area, abundant in local area, 12 August 1960, *McGregor* 15924; swampy area along Spring River, 26 August 1969, *Bare* 2169. The Bourbon Co. collections represent the first area in Kansas other than se Cherokee Co. where this species is known to occur.

Thymelaea passerina (L.) Cosson & Germ. KANSAS: CLOUD CO.: 1 mi n Concordia, flood-plain of Republican River, sandy soil, willow thicket, scattered, 11 September 1970, *McGregor* 23572. This species has been reported for North America from west-central Iowa, northeastern Nebraska and extreme western Nebraska. European manuals indicate that the species is a common weed in dry soils and appears commonly in grain fields of south and central Europe and western Asia.

Centunculus minimus L. KANSAS: MONTGOMERY CO.: 12 mi sw Independence, at Camp Wilderness, along damp draw in oak woods, 20 June 1970, *Holland* 2812c, in part. This represents an extension of the species westward from Missouri and northward from eastern Oklahoma.

Glaux maritima L. NEBRASKA: SIOUX CO.: n edge of Agate, flat prairie swale near Niobrara River, sandy soil, 16 August 1970, *Stephens* 43966. This species occurs in North Dakota, but is not known from South Dakota.

Sabatia campestris Nutt. f. **albiflora** D. M. Moore. KANSAS: CHEROKEE CO.: 0.4 mi w & 1 s of Baxter Springs, in prairie in soil over limestone, abandoned rock quarry area, 17 July 1969, *Johnson* 2259, in part. MONTGOMERY CO.: 2 mi s & 0.2 w of Sycamore, prairie hay meadow, sandy clay soil, rare, 12 July 1969, *Weedon* & *Magrath* 5516. WILSON CO.: 4.5 mi e Neodesha, sandy blue stem prairie, scattered, 4 July 1970, *McGregor* 22386.

Eustoma grandiflorum (Raf.) Shinners f. **album** (Holzinger) Waterfall. KANSAS: RICE CO.: 0.5 mi s of Sterling, heavily grazed pasture, sandy soil, one plant seen, 9 August 1970, *Magrath* & *Weedon* 5754. STAFFORD CO.: T21S, R11W, Sec 21, found in dense *Spartina* area, very rare, 13 August 1958, *Ungar* 666a.

Apocynum medium Greene. KANSAS: DOUGLAS CO.: ¼ mi s of Lone Star, thin soil over limestone, abundant on old slope of roadcut, 11 June 1969, *Johnson* 2081; 14 June 1970, *Johnson* 2496. This extends the range of this species westward from Missouri.

Asclepias incarnata L. var. **incarnata** f. **albiflora** Heller. KANSAS: COFFEY CO.: 6.5 mi n & 1.5 w of Westphalia, growing near edge of large pond, moist loam, one plant, 5 September 1970, *Magrath* 6136. DOUGLAS CO.: in old roadbed at southern end of Baldwin Lake, 15 August 1961, *Richards* 3686; 1 mi s & 1.5 e of Baldwin City, growing at edge of lake, six plants, 19 August 1969, *Bare* 2114. NEBRASKA: DODGE CO.: Fremont Lakes Rec. Area, 3 mi w of Fremont on US 30, growing along se edge of lake, one white flowered plant in large colony of pink flowered plants, sandy loam, 21 August 1970, *Magrath* 5978.

Hydrophyllum appendiculatum Michx. NEBRASKA: DOUGLAS CO.: Omaha, wooded ravine s of Hummel Park, 6 June 1968, Sutherland 1689. This extends the range of this species northward from Kansas and northwestward from Missouri.

Scutellaria brittonii Porter. NEBRASKA: KIMBALL CO.: 2 mi w Kimball, upland prairie, dry sandy-gravel soil, 14 June 1967, *Stephens* 11664; 8 mi sw, 1.5 w Bushnell, open pine-prairie hilltop, dry rocky clay soil, few plants, 5 June 1969, *Stephens* & *Brooks* 31479; 29 June 1970, *Stephens* & *Brooks* 40859. This species also occurs in Wyoming, Colorado and New Mexico.

Leonurus marrubiastrum L. NEBRASKA: DOUGLAS CO.: 4 mi e of Venice on N 92, Elkhorn River, slip-off bank s of bridge, muddy silt with some sandy spots, rare, 21 August 1970, *Magrath* 5968. NEMAHA CO.: 8.1 mi s of Auburn on US 73 & 75, riverbed e of bridge, slip-off bank, silty-sandy clay, scattered, *Magrath* 5931. SOUTH DAKOTA: HUTCHINSON CO.: 0.5 mi e Olivet, bank of James River, moist sandy soil, abundant, 8 September 1970, *Stephens* 44866. This extends the range of the species northward from Kansas and northwestward from Missouri.

Lamium amplexicaule L. f. **albiflorum** D. M. Moore. KANSAS: DOUGLAS CO.: City of Lawrence, 2 blocks n of 23rd St. & 1 block e of Pennsylvania St., one plant, growing in pasture, loam, 30 April 1971, *W.* & *T. Vollmer*, s.n. COFFEY CO.: 1 mi n, 7 w on US 50 of Waverly, roadside park, growing in ditch, loam, uncommon, 22 May 1972, *Magrath* 7407.

Solanum sarrachoides Sendl. KANSAS: NEOSHO CO.: 4 mi s & 5 e Erie, in farmyard near fence rows, 29 September 1970, *Holland* 2840. This is a South American species that has been introduced into North America. It is known otherwise only from Jasper and McDonald Counties in Missouri and northeastern Oklahoma.

Mimulus alatus Ait. f. **albiflorus** House. KANSAS: FRANKLIN CO.: Ferndale, 1.5 mi s, 1 e & 1¼ s of Homewood, muddy creek floodplain near base of sandstone bluffs, one plant, 29 August 1970, *Magrath* 6125. LINN CO.: stream channel just n of Mound City, just e of bridge on K 7,

surfacing limestone, rare, 7 August 1970, *Weedon & Magrath* 6546.

Agalinis heterophylla (Nutt.) Small. KANSAS: CHAUTAUQUA CO.: 1.6 mi ne of Sedan, oak woods over sandstone, rare, 14 September 1970, *Magrath* 6224. CHEROKEE CO.: 2.1 mi w of Jct of US 166 & 69 on 166, 1.6 s & 0.2 e, abandoned rock quarry, rocky limestone soil, common, 14 September 1970, *Magrath* 6243; 1 mi w Baxter Springs, scattered in prairie, 3 October 1970, *McGregor* 23641. GREENWOOD CO.: 0.6 mi e of Sallyards on US 54, rocky prairie hay meadow, one plant found, 13 September 1970, *Magrath* 6201A. This extends the range of the species westward from Lawrence and Dunklin Counties in Missouri and northward from Oklahoma.

Orobanche multiflora Nutt. KANSAS: SCOTT CO.: 12 mi n & 3 w of Scott City, gravelly prairie hillsides with caliche outcrops, only one plant seen, 3 October 1970, *Bare* 2605. This extends the range of the species northward from Oklahoma and eastward from Colorado.

Triodanis biflora (R. & P.) Greene. NEBRASKA: JOHNSON CO.: 3.2 mi s of Cook on N 50, grazed pasture, loam, rare, 28 June 1970, *Magrath & Hays* 5639A. PAWNEE CO.: 0.6 mi s of Pawnee-Johnson Co. line on N 50, prairie hay meadow, in disturbed area, loam, rare, 28 June 1970, *Magrath & Hays* 5642. This is an extension northward of this species from Kansas.

Lobelia siphilitica L. var. **siphilitica** f. **albiflora** Britt. KANSAS: DOUGLAS CO.: 1.5 mi e of Lecompton, Kansas River bluff, moist ditch, 19 September 1968, Bare 1944.

Iva axillaris Pursh. KANSAS: FINNEY CO.: river bank, 18 July 1912, *Wilson & Miller*, s.n. HAMILTON CO.: 1 mi s, 1 e of Coolidge, prairie roadside right-of-way, moist sandy soil, locally abundant, area 25 ft. across, 3 August 1971, *Stephens* 50368. These are extensions of the range of this species southward from Nebraska and eastward from Colorado.

Helianthus mollis Lam. NEBRASKA: RICHARDSON CO.: 1.4 mi e of Humboldt on N 4, prairie pasture, loam, uncommon, 26 September 1970, *Magrath* 6336A. WEBSTER CO.: 2 mi s, 3 w Red Cloud, sandy prairie hillside, rare in the area, 11 August 1965, *McGregor* 19479. This is an extension of the range of the species northward from Kansas.

Bidens comosa (Gray) Wieg. WYOMING: GOSHEN CO.: side channel of North Platte River w of city park in Torrington, sandy to clay loam soil, scattered, 28 September 1968, *Weedon* 4787; North Platte River on s edge of Torrington, both banks of river, sandy soil, scattered, 28 September 1968, *Weedon* 4789. WASHAKIE CO.: Worland, in a wet saline area, 16 July 1966, *Tresler* 322 (RM). According to Sherff (1937), the distribution of this species is from Maine, Quebec and North Dakota southward and southwestward to North Carolina, Tennessee, New Mexico and Utah. It has also been reported from eastern Colorado.

Artemisia annua L. KANSAS: DONIPHAN CO.: 1 mi n White Cloud, bank of Missouri River, willow thicket, several large colonies, 29 August 1970, *McGregor* 23467. This is the second known record for the state.

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DEPARTMENT OF BOTANY
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NEW RECORDS OF NORTH DAKOTA PLANTS

O. A. STEVENS

In 1961 I gave a ten-year supplement to my Handbook (Stevens 1950), which was incorporated as an (unpaged) appendix to the third printing of the book (1963). The intention was to provide a second supplement in 1970, but at that date active collecting was proceeding, especially in the western part of the state and this supplement was postponed. In the meantime several partial lists have appeared and it seems desirable not to postpone this one longer.

In addition to species which are reported for the first time (marked with *), a few significant additional locations for other species are included. Mere changes in names are usually not mentioned.

Botrychium lunaria L. was found in Burke County in 1971 by *Glen Hegstad.*

**Equisetum palustre* L. was reported by Barker (1971) for Ransom County.

**Equisetum scirpoides* Michx. was reported by Stewart (1970) from Barnes County.

**Pinus banksiana* Lamb. Several cone-bearing and seedling trees were found near McLeod, in Richland County in 1970 (*Gerald Seiler* 1775). This is presumably a forest planting but the record has not been found.

**Bromus squarrosus* L. Abundant in an abandoned, sandy field, Kidder County in 1971, *Stevens* 3292, 3294.

**Chloris virgata* Sw. This probably was an escape from S C S nursery at Mandan, Morton County, September 13, 1962, *Geo. Karey.*

**Cinna arundinacea* L. was collected at two locations in Ransom County, *Stevens* 2742, 2761.

**Eragrostis spectabilis* (Pursh) Steud. was reported by Barker (1971) from Ransom County.

**Polypogon monspeliense* L. is recorded from LaMoure County, *H. Kantrud,* September 30, 1970; Slope County in 1970, *Zaczkowski* 4000; Williams County in 1971, *G. D. Hegstad.*

**Triplasis purpurea* (Walt.) Chapm. was collected in two places in Richland County in 1964 (*W. Wanek* 124).

**Sporobolus airoides* Torr. is confirmed by *N. Zaczkowski* 3012, 3017, and 4257.

**Carex alopecoidea* Tuckerman was reported by Stewart (1970). I had tentatively placed here a specimen from Richland County, *Stevens* 88. O. A. Kolstad at the University of Kansas, who examined all of our North Dakota *Carex* in 1965, put this as *C. stipata* but part of a sheet of *stipata* in *C. alopecoidea.* Presumably all five stalks were from one clump (which proves nothing). Kolstad referred to *alopecoidea* one specimen from Barnes County, *Stevens* in 1950.

*Carex capillaris L. Bottineau County in 1961, Stevens 2499.

Carex davisii Schw. & Torr. Our specimens reported as *C. gracillima* were placed here by Kolstad. Stewart (1970) reported **C. buxbaumii,* **C. lacustris,* **C. lasiocarpa,* **C. limosa* and **C. vesicaria.*

**Iris missouriensis* Nutt. A specimen was received, but not saved, from Mrs. Paul DeKrey, Tappen, Kidder County in 1968. G. D. Hoag visited the place and reported a number of clumps in a depression of the prairie. Richard Williams found it in northeastern Emmons County in 1971.

**Juglans nigra* L. can be regarded as naturalized because it is often planted and squirrels carry the nuts to other places. At least three seedlings appeared in our yard, presumably from nuts from a tree across the street (one, replanted about 15 years ago is still growing) and I have seen others at several places.

**Juncus vaseyi* Engelm. A specimen from Bottineau County was determined by L. J. Harms.

Quercus ellipsoidalis E. J. Hill. Little (1971, map 163 E) shows this extending into Richland County but we have no knowledge of such (may be planted).

Atriplex glabriuscula Edmonst. The specimens reported as this (Stevens, 1963) are now referred to *A. heterosperma* Bunge by Aellen and by Frankton (1968) who

uses *A. subspicata* (Nutt.) Rydb. for what we had called *A. hastata,* but retained one specimen from Richland County, *Bell* 377, as *A. hastata,* also one from Clay County, Minnesota.

**Lychnis chalcedonica* L. We have two specimens, presumably escapes. Benson County, *J. Lunell* in 1917 "bordering a slough", and Dickey County, *K. M. Larson* in 1965.

**Salix pedicillata* Pursh was collected in McHenry County, *Stevens* 3225, in the fen cited by Stewart (1970).

Eriogonum gordoni Benth. was reported as *E. trichopes* (Stevens 1960) but apparently is *E. gordoni* or close to it. Further specimens are from Burke and Mountrail Counties in 1970 by *Hegstad.*

Anemone multifida Poir. from Golden Valley County was a surprise, *N. Zaczkowski* 364, 3481.

**Ranunculus cardiophyllus* Hook. A specimen collected in McKenzie County in 1967 by *C. A. Barr* seems to be this species.

Alyssum desertorum Stapf. apparently is the proper name for that reported (Stevens 1963) as *A. alyssoides.* Better specimens are from the same county by Zaczkowski.

**Arabis glabra* Gray. Two specimens from Dunn County, *Stevens & Moir* 2255 and Sept. 14, 1956, and one from Burke County, *Stevens,* July 20, 1966, seems to belong here.

Chorispora tenella (Pall.) D.C. A second record is from Billings County, *Zaczkowski* 3333.

**Erysimum repandum* L. A single specimen collected on the campus in 1967 seems to be this species.

**Berberis repens* Lindl. was reported by Barker (1971) from Bowman County.

**Ribes cereum* Dougl. A sterile specimen was collected by *Jack Nelson* at Pretty Butte, western edge of Slope County, in 1960. *Nick Zaczkowski* collected flowering specimens there in 1970.

**Potentilla palustris* L. was reported by Stewart (1970) from McHenry County.

**Astragalus purshii* Dougl. was reported by Zaczkowski

(1970). It was identified by Fernald from a specimen which I collected in McKenzie County July 15, 1943. Another was collected in Emmons County in 1945. Walsh (1960) referred these to *A. lotiflorus.*

Caragana arborescens Lam. Glen Hegstad, who has been studying our northwestern counties extensively, reports apparent establishment. This area had many farmsteads abandoned after 1934.

Lotus corniculatus L. has become quite common along streets and lawns in the Fargo area.

Polygala senega L. Three collections by *Hegstad* in Burke County, 4770, 5413, 8038, extend the known range of this species.

**Euphorbia stictospora* Engelm. A specimen, *Bell* 1072, said to have been collected in the dooryard of a ranch in 1907 in McKenzie County was determined as this by Richardson (1968). It must have been a chance introduction.

**Rhamnus davurica* Pall. In 1965 I saw in Ransom County a windbreak of this, containing great numbers of seedlings. A second record is from *O. J. Lung* in 1964 from Emmons County ("came up in garden"). The fruits seem not usually eaten by birds.

Acalypha rhomboidea Raf. A second specimen is from Stutsman County, Sept. 3, 1964, Mrs. *Amy Rolling*, "came up in flower bed".

**Acer saccharinum* L. is often planted as a street tree. Two to three year old seedlings were collected by a hedge near a large maple tree in 1970, *Stevens* 3285.

**Lavatera cretica* L. was collected in Divide County on Aug. 20, 1969 by *L. M. Mitich* and by *Hegstad* (6239) in Burke County in 1970; escaped from, or persisting from, gardens.

Hypericum perforatum L. A second specimen, *Stevens* 3152, in Ransom County on the Sheyenne River bank by an old farm house, may have been planted. There were several plants but no new ones.

**Gaura parviflora* Dougl. reported by Barker (1971)

from Golden Valley County is probably a railroad introduction.

Conium maculatum L. was collected in Golden Valley and Billings Counties in 1969 and 1970 by Zaczkowski.

Osmorhiza claytoni (Michx.) C. B. Clarke. A second record was by *V. Facey*, Grand Forks County in 1958.

**Halenia deflexa* (Sm.) Griseb. was reported by Barker (1971) from Pembina County (KANU).

Phlox alyssifolia Greene was collected on Bullion Butte, Stark County, *Zaczkowski* 2329 in 1970.

Physostegia parviflora Nutt. I am inclined to think that our plant should be considered a variety of *P. virginiana* L. It is uniformly leafy, the leaves 1-2 (–5) cm wide, sharply toothed, flowers 15 (–18) mm long. Specimens of *P. formosior* Lunell, so labeled by Lunell, do not differ materially, but one from the same area labeled *P. parviflora* has the lower leaves narrowly oblong with blunt, low teeth. One from McLean County (*V. T. Heidenreich* 210) has leaves about 7 mm wide and some from Burke County (*Hegstad* 8458) have narrow leaves and blunt teeth but his 5943 from within ten miles of the same place agrees with our eastern specimens.

**Lythrum salicaria* L. is much planted and a considerable colony developed in a low, roadside area at Fargo (*Stevens* 2332). I found one plant at a similar place about one mile distant.

Stachys palustris L. The prevalent form in open, usually moist ground, has rather densely, evenly pilose stems (*S. scopulorum* Greene?). Along wooded streams in the eastern edge of the state the mid and lower stems often are nearly glabrous, with a few, retrorse, coarser, often somewhat pustulate, hairs on the angles and a few or more soft hairs on the sides. The calyx varies from sparsely to more densely pilose, rarely with short, glandular hairs.

**Collinsia parviflora* Lindl. was found in Slope County, *Zaczkowski* 3072.

**Pentstemon procera* Dougl. was reported by Barker (1971) from Burke County.

**Chaenorrhinum minus* (L.) Lange was collected along a formerly used railway track at Valley City, Barnes County in 1963, *Stevens* 2670. The area was pastured and plants not seen in 1971.

Veronicastrum virginicum (L.) Farwell. *Roys Willenbring*, collecting in Pembina County 1969-71, found a few plants near Cavalier, Pembina County, 799.

**Galium verum* L. One specimen is from Dickinson, Stark County in 1912, *C. H. Waldron* 130. I recall that perhaps about 1935, Dr. L. R. Waldron showed me a fragment of it. In 1967 I discovered a colony of it in a yard near his house, and distributed several sheets, *Stevens* 3028. In 1970 I looked again but did not find it.

**Sambucus pubens* Michx. In 1964 I visited a farm grove near Colfax, Cass County, where this plant had apparently been introduced and spread through the grove and along fence lines. Some years ago it had spread through the university's woody plantings but was eradicated.

**Ambrosia (Franseria) tomentosa* (A. Gray) Payne. A colony appeared in garden plots of the University at Fargo in 1963 (*Stevens* 2693). Another specimen is from Grand Rapids, LaMoure County, *Bill Shak*, Aug. 21, 1921.

Aster ciliolatus Lindl. This name apparently should be used for what has been called *A. sagittifolius* L. I have been unable to make satisfactory conclusions.

Bidens acuta (Wieg.) Britton. I still feel that this is a better "species" than many others. In our area it is quite striking, usually with sessile leaves, heads the size of those of *B. vulgata* with 2-3 cm long, leafy, outer bracts. The long-petioled leaves of *B. comosa* are lacking.

Centaurea maculosa Lam. A large colony of an acre or more was found along State Highway 1 in Nelson County at the outlet of Stump Lake in 1962, *Stevens* 2962.

**Chaenactis douglasii* (Hook.) H. & A. This is another extension from the west in Bowman County, Zaczkowski.

Crepis tectorum L. I had used the name *C. capillaris*, first on a specimen by *Lunell* from Bottineau County, but I believe it is *C. tectorum* which is quite common in the

Cavalier-Pembina area and spreading more widely. It is also abundant in western Becker County, Minnesota.

**Erigeron canbyi.* Specimens from the Killdeer Mts., Dunn County, by *C. A. Barr,* May 8, 1963, were considered this form by Mr. Barr.

Hymenopappus tenuifolius Pursh. Collections from Benson County, *W. T. Barker* 5567, make a notable eastern range extension.

**Senecio vulgaris* L. was received from Dickinson, Stark County in 1954; *Stevens* 1558 in 1955. Another garden location is at Fargo, Cass County in 1962, *Stevens* 2648, 2870. It had been found at Hawley, Clay County, Minnesota.

**Thelesperma marginatum* Rydb. was collected in Williams and Divide Counties, *Hegstad* 3095, 3552, 5798, 8030, in 1969-71.

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PRIORITY OF THE BINOMIAL PYROLA CHLORANTHA

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Some confusion exists in the literature concerning the usage and priority of the binomials *P. chlorantha* Swartz and *P. virens* Schreber in Schweigger & Koerte. The most commonly used binomial for the green-flowered shinleaf in Europe up to and including the present time, and in North America until 1941, was *P. chlorantha* (Swartz, 1810). Fernald's short note (1941) in which he cited *P. virens* as antedating *P. chlorantha* by six years resulted in the common acceptance of the former name in most North American publications. However, the Flora Erlangensis of 1804 does not mention *Pyrola virens*.

It becomes clear, however, that *P. chlorantha* has priority over *P. virens* when the publication containing the original description of *P. virens* is closely examined (Schweigger & Koerte, 1811). The 1811 publication, Flora Erlangensis, is composed of two parts plus an Addenda et Corrigenda to Part I. The pagination of the addendum is sequential to that in Part I which is taken directly from a doctoral dissertation by Schweigger (1804).

A. F. Schweigger and F. Koerte published Flora Erlangensis in 1811 at which time the addendum as well as Part II were bound with a facsimile of the 1804 publication. The title page for the addendum bears neither of the authors' names, whereas the author of Part I is clearly indicated as being Schweigger and the authors of Part II as being Schweigger and Koerte. In the preface to the com-

plete volume written by Koerte, it is stated that all the additions which are preceded by an asterisk are the work of J. C. D. von Schreber, who had reviewed the manuscript. *P. virens* on p. 154 of the addendum is preceded by an asterisk. There appears to be no question that the valid date of publication of *P. virens* is 1811, one year after the publication of the binomial *P. chlorantha.* The correct citation for the former is as follows: *P. virens* Schreber in Schweiger & Koerte, Fl. Erlang. I, add. p. 154. 1811.

The author would like to express his appreciation to Dr. John W. Grear Jr. for his assistance in obtaining reproductions of pertinent sections of the original publications by Schweigger and Koerte.

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CHROMOSOME NUMBERS OF SCIRPUS PURSHIANUS AND S. SMITHII

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Two eastern North American aquatic bulrushes, *Scirpus purshianus* Fern. and *S. smithii* Gray, superficially resemble one another and have been confused in taxonomic literature. Beetle (1942) stated that, "Apparently *S. smithii* is no more than an aquatic extreme of *S. debilis* [an earlier name applied to plants of *S. purshianus*]," while Fernald (1942) maintained, ". . . all living botanists who accurately know living plants in the field find them abundantly distinct." Some botanists (Gleason and Cronquist, 1963) have continued to treat these species in accordance with Beetle's statement and others (Seymour, 1969) have conformed with Fernald's statement. The characteristics used by Fernald to delineate *S. purshianus, S. smithii,* and their forms are accepted here and the following discussion is in accordance with his treatment of these taxa in Gray's Manual (Fernald, 1950).

Part of the taxonomic confusion with *S. purshianus* and *S. smithii* is probably caused by the similar pattern of infraspecific variation of each species. Each has ecologically differentiated forms characterized morphologically by the presence or absence of well-developed barbed bristles attached to the achenes. *S. smithii,* which often appears to be associated with somewhat alkaline substrates, has three described forms: f. *levisetus* (Fass.) Fern. (having nearly smooth bristles), f. *setosus* (Fern.) Fern. (having well-developed barbed bristles), and f. *smithii* (lacking bristles). *S. purshianus,* which often appears to be associated with more acid substrates, has two forms: f. *purshianus* (having well-developed barbed bristles) and f. *williamsii* (Fern.) Fern. (lacking bristles).

In both *S. purshianus* and *S. smithii,* the presence or absence of barbed bristles appears to be correlated with the stability of the habitat. For example in eastern New York, New Jersey, eastern Pennsylvania, and Delaware, *S. smithii*

f. *smithii* is almost completely restricted to the specialized conditions of fresh inter-tidal zones of the Hudson, Raritan, and Delaware Rivers while in the same area f. *setosus* occurs in and around lakes, ponds, and quagmires (see Long, 1910, for a discussion of these forms in the vicinity of Philadelphia). *S. smithii* f. *levisetus* is common in the estuaries of the Kennebec River in Maine and the St. Lawrence River in Quebec. Although bristles are present in f. *levisetus,* they lack the prominent barb-like teeth characteristic of f. *setosus.* Thus it appears that plants of *S. smithii* which lack barbed bristles are better adapted to the periodic fluctuation in water level characteristic of the estuarine environment than are those which have barbed bristles. A similar pattern emerges for *S. purshianus* f. *purshianus* and f. *williamsii,* although tidal fluctuation in water level is not involved since neither form grows in tidal estuaries. However, f. *williamsii* is frequently found on the sandy shores of lakes in Cass, Kalamazoo, and Van Buren Counties in southwestern Michigan while the more widespread f. *purshianus* is infrequently found in this area. There is (or was) considerable water level fluctuation in these southwestern Michigan lakes from spring to fall, a factor which probably is a barrier to plants adapted to lake shores with more uniform water levels. This may be what excludes f. *purshianus* from many southwestern Michigan lakes since, throughout most of its range, it often grows along lake shores with relatively uniform water levels. Thus the forms of both species having barbed bristles appear better adapted to relatively stable conditions associated with little or moderate water level fluctuation while the forms lacking barbed bristles appear better adapted to relatively unstable conditions associated with substantial water level fluctuation.

Despite the ecological and morphological resemblance between forms of these two species, I have always found that the morphological criteria used by Fernald to distinguish them are reliable. In addition, the chromosome numbers determined for the forms of each species provide evidence

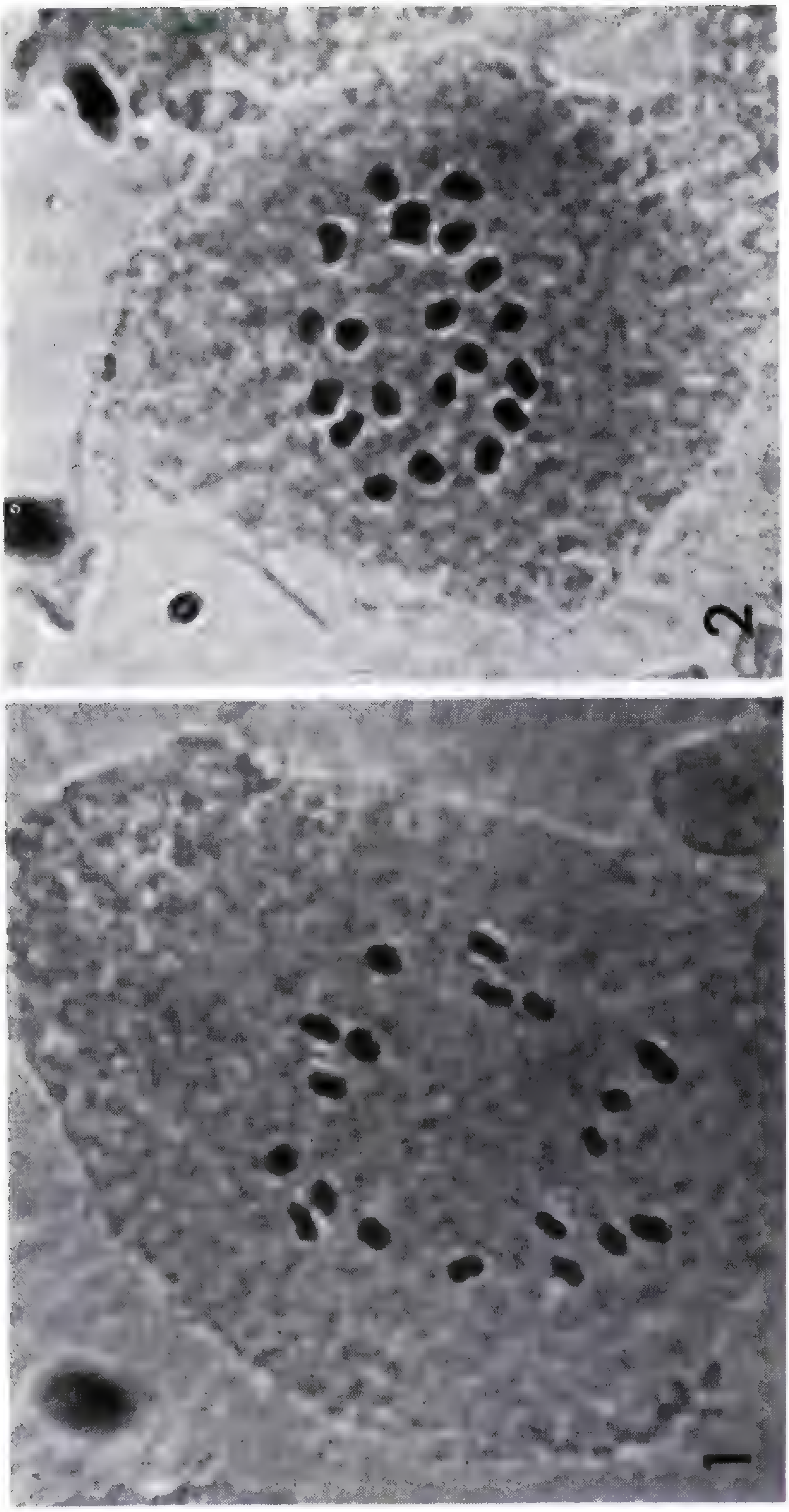

Fig. 1. Meiotic chromosomes of *S. purshianus* (*Schuyler 4265*).

Fig. 2. Meiotic chromosomes of *S. smithii* (*Schuyler 4276*).

supporting Fernald's treatment. 19 meiotic units (Fig. 1) were observed in pollen mother cells of *S. purshianus* f. *purshianus* and f. *williamsii* (Table 1). 20 meiotic units, with one unit consistently larger than the rest (Fig. 2), were observed in pollen mother cells of *S. smithii,* f. *levisetus,* f. *setosus,* and f. *smithii* (Table 1). Ordinarily, chromosome numbers are consistent for a given species of *Scirpus* and provide evidence corroborating distinctions among them. The chromosome numbers reported here support the specific recognition of *S. purshianus* and *S. smithii* and indicate that the infraspecific taxa are associated with the proper species in Fernald's treatment.

TABLE 1. Chromosome Numbers Determined for Forms or *Scirpus purshianus* and *S. smithii*

Taxon	Number of Meiotic Units	Voucher Specimens[a]
S. purshianus f. *purshianus*	19	Massachusetts: Barnstable Co., 4265; Pennsylvania: Northampton Co., 3819; Pennsylvania: Berks Co., 4088
S. purshianus f. *williamsii*	19	Michigan: Kalamazoo Co., 3903
S. smithii f. *levisetus*	20	Maine: Sagadahoc Co., 4276
S. smithii f. *setosus*	20	New Jersey: Sussex Co., 4201
S. smithii f. *smithii*	20	New Jersey: Burlington Co., 4203

[a]All are collections by the author preserved at the Academy of Natural Sciences.

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1966. Vincent Abraitys, Florence M. Givens, Patricia R. Schuyler, and Henry K. Svenson helped in connection with field work, Karen Keil did chromosome squashes, and Helena Greenwood typed the manuscript.

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TUSSILAGO FARFARA L. (SENECIONEAE-ASTERACEAE) IN VIRGINIA

MILES F. JOHNSON

Tussilago farfara, the Coltsfoot, a perennial rhizomatous herbaceous native of the Old World with a single yellow head terminating a scaly bracted scape in early spring, and developing large cordate leaves later, was seen in a newly developed City Park in Richmond, Virginia, in April, 1971. A survey of the manuals for this area (Fernald, 1950; Gleason & Cronquist, 1963; Harvill, 1970) showed *T. farfara* absent from Virginia. However, a survey of other literature and herbaria proved that the Richmond specimen was not a new state record.

This paper is based upon collections at herbaria of the following institutions: Virginia Polytechnic Institute and State University, Blacksburg, Lynchburg College, Lynchburg, College of William and Mary, Williamsburg, Virginia Commonwealth University, Richmond, and the United States National Museum, Smithsonian Institution, Washington, D.C. I wish to acknowledge aid of the directors and (or) curators at these herbaria.

The first known collections of *Tussilago* in Virginia include *Freer* 2627 (Lynchburg, US), from route 39 near McClung, Bath County, *Freer* 2628 (Lynchburg, US) collected from the west side of Lantz Mountain, Highland County, *Freer* 2686A (VPISU) from Rockbridge County and *Gwynn* s.n. (VPISU, US) from Warren County; all specimens were collected in 1962. See Fig. 1. The first known published report of *Tussilago* in Virginia is that of Freer (1968) from Rockbridge County.

A general migration of *Tussilago farfara* in the United States from north to south is noted in Fernald (1.c.) and Gleason & Cronquist (1.c.). Fernald (1.c.) lists the species ranging from Newfoundland to its southern limits in New Jersey, Pennsylvania and Ohio though Reed (1951) records *Tussilago* in Baltimore County, Maryland, as early

as 1903 and Strausbaugh and Core (1964) report this species in West Virginia in 1933. Gleason and Cronquist (l.c.), publishing 13 years later than Fernald, indicate a southern range extension to Maryland and West Virginia.

It is apparent that the southern migration of *Tussilago* is continuing at present. This species entered West Virginia in 1933 in Monongahela County which borders on southwestern Pennsylvania and by 1964 was abundant in Kanawha County in southern West Virginia and probably in every county of the state (Strausbaugh and Core, l.c.). Migration continued and *Tussilago* seems to have entered Virginia from the west in the early 1960's (Fig. 1).

The migration pattern within Virginia perpetuates the trend southward and eastward (Fig. 1). It is noted that the earlier collections were made in the mountains and that the majority of the recent ones have come from the Piedmont and Coastal Plain. The plant in Richmond was seen in sandy, disturbed soil immediately adjacent to the James River. The river, the headwaters of which rise in western Virginia, may well have transported the diseminule from which the specimen grew. Thus, the range of *Tussilago farfara* in the United States should be extended to include Virginia and this interesting species should become part of the treatment of the Flora of Virginia now in preparation.

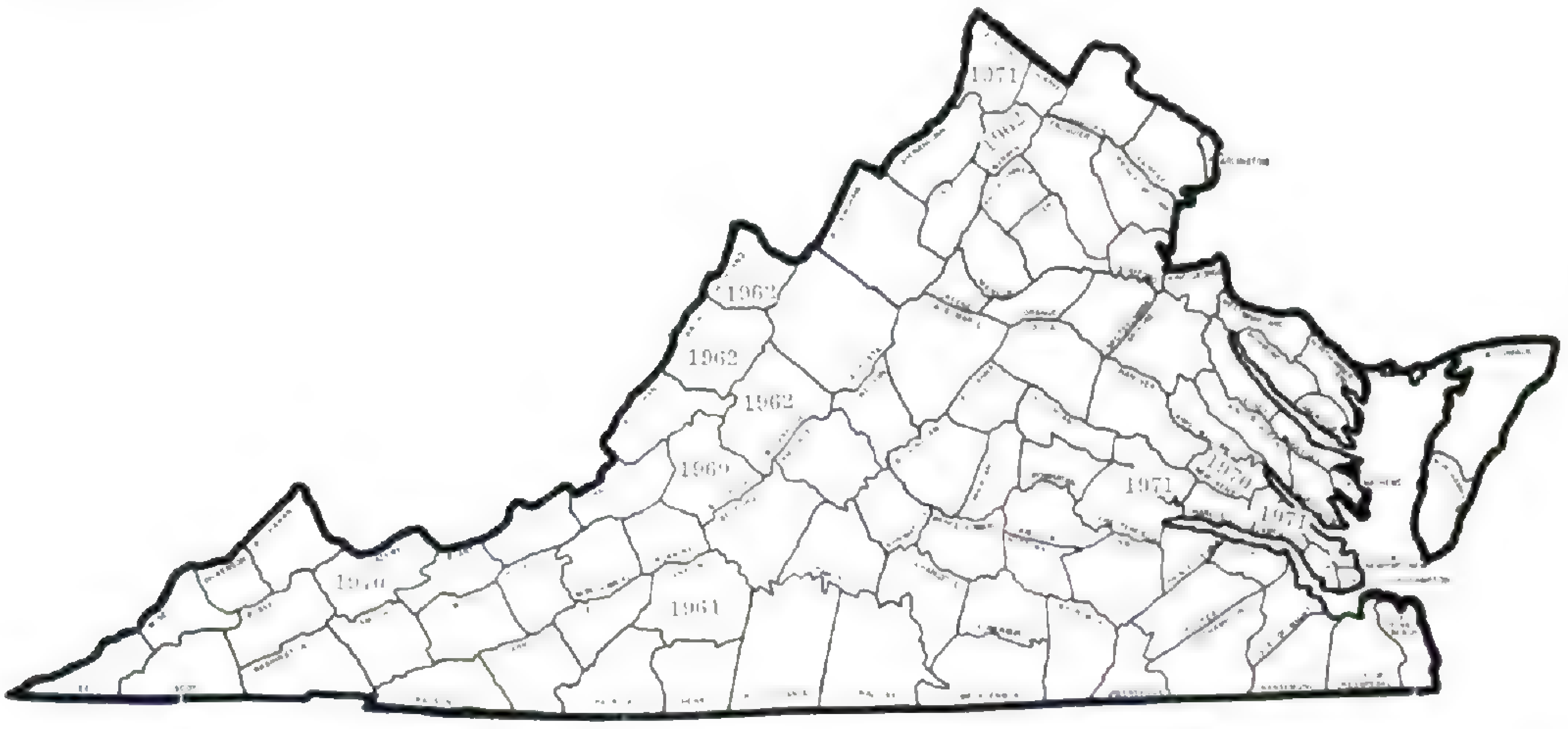

Figure 1. Distribution of *Tussilago farfara* in Virginia. Dates indicate the earliest known collection from each county.

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INVESTIGATIONS OF NEW ENGLAND MARINE ALGAE V. THE ALGAL VEGETATION OF THE HAMPTON-SEABROOK ESTUARY AND THE OPEN COAST NEAR HAMPTON, NEW HAMPSHIRE[1]

Arthur C. Mathieson and Richard A. Fralick

Most botanical studies of New England salt marshes have been restricted to Massachusetts (e.g. Chapman, 1940; Drum and Webber, 1965; Webber, 1967, 1968; Webber and Wilce, 1971) and Connecticut (e.g. Miller and Egler, 1950) and little is known of these valuable wetlands in New Hampshire salt marches (i.e. Davis, 1956; Vagenas, 1969). Davis summarized the general ecology of the Crommet Creek Estuary, which is a small tributary of Great Bay, New Hampshire. Vagenas studied the seasonal occurrence, composition and zonation of algae and flowering plants at five locations in the Hampton-Seabrook salt marsh. For the past seven years we have conducted a variety of floristic and ecological studies of the marine algae on the open coast of New Hampshire and the Great Bay Estuary System (Mathieson, Hehre and Reynolds, in press; Mathieson, Reynolds and Hehre, in press; Hehre and Mathieson, 1970). The present investigation was initiated, at the request of Normandeau Associates Incorporated, in order to provide a broad "baseline" of information regarding the species composition, distribution and ecology of the benthonic marine algae of the Hampton-Seabrook Estuary and the adjacent open coast of New Hampshire (Fig. 1).

Collections and observations of marine algae were made at fifty-four stations in the Hampton-Seabrook Estuary and the adjacent open coast of New Hampshire (Fig. 1 and Table I) during the summer and fall of 1969. Prior to 1969 seasonal collections had been made on the open coast near

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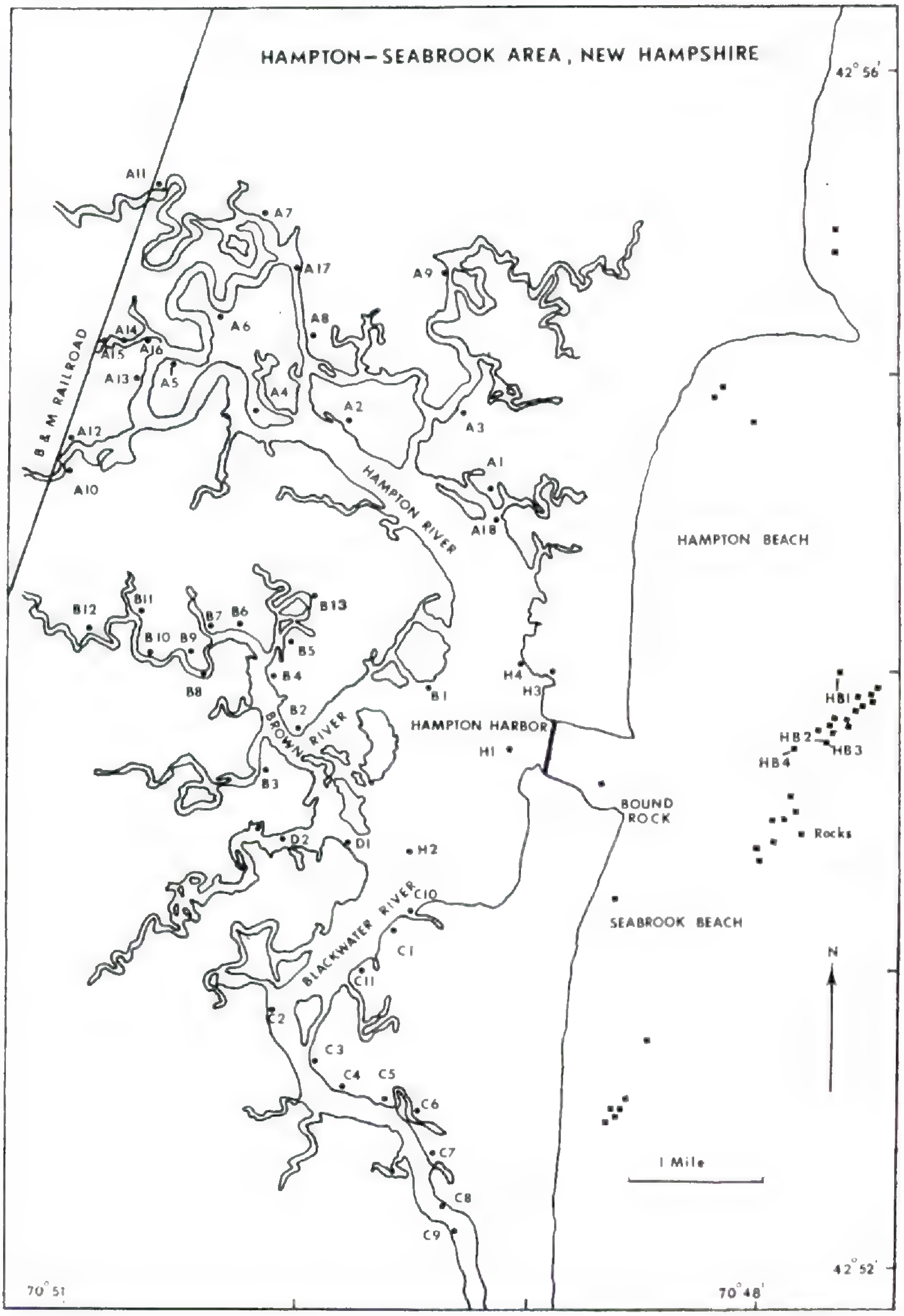
Bound Rock, and limited collections were made in the estuary (during the fall and winter of 1966). The majority of the stations were established by Normandeau Associates in conjunction with their ecological survey of the estuary. The estuarine sites were identified by a pair of numbered stakes on opposite sides of the channel, and most of the collections were restricted to the side of the channel numbered on the map (Fig. 1) unless conspicuous differences were noted on the two sides. The locations were primarily shore sites, but a few offshore outcrops of rock were also studied (Fig. 1). An aluminum boat and outboard motor were used at most stations.

Representative samples of all conspicuous algal species were obtained at each station. Collections were made in the littoral (on foot) and sublittoral zones (by SCUBA). Extensive collections were made in the sublittoral zones on the open coast, but because of poor visibility, tidal currents and limited substrate for seaweed attachment, fewer sublittoral samples were available in the Estuary. A complete set of nearly 700 herbarium voucher specimens has been deposited in the Algal Herbarium of the University of New Hampshire (NHA). The nomenclature of the Second Revised British Checklist (Parke and Dixon, 1968) has been applied in most cases. The vertical distribution of the major algal components described in this article is given according to the biological classification of Lewis (1964).

A record of surface water salinity and temperature was made at most stations with a thermometer and a set of hydrometers. All of the salinity values were corrected to 15 C. Diurnal variations of temperature, salinity and current speed were recorded at one location (station C-9) during a twelve hour period. The current speed was recorded with a Little Captain boat speedometer (Swift Instrument Company of Boston, Massachusetts), which was modified with a six-foot well tube.

Table II summarizes the surface water temperature and salinity values recorded (1966-1969). The hydrographic conditions on the exposed open coast (Bound Rock) are


HAMPTON–SEABROOK AREA, NEW HAMPSHIRE
42° 56'
42° 52'
70° 51'
70° 48'
B & M RAILROAD
HAMPTON RIVER
BROWN RIVER
BLACKWATER RIVER
HAMPTON HARBOR
HAMPTON BEACH
SEABROOK BEACH
BOUND ROCK
Rocks
N
1 Mile
A1
A2
A3
A4
A5
A6
A7
A8
A9
A10
A11
A12
A13
A14
A15
A16
A17
A18
B1
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B10
B11
B12
B13
C1
C2
C3
C4
C5
C6
C7
C8
C9
C10
C11
D1
D2
H1
H2
H3
H4
HB1
HB2
HB3
HB4

more uniform than in the Estuary — particularly at the headwaters of the tidal rivers. Gross fluctuations (both daily and seasonally) of temperature and salinity are evident at any estuarine location. Figures 2 and 3 summarize the results of a twelve hour study made at station C-9 on the Blackwater River. The location has a pronounced tidal current; thus, vertical mixing of the water column is evident and there is no stratification. Diurnal variations of temperature and salinity varied from 13.2 to 16.0 C and 11.5 to 14.5 0/00, respectively (Fig. 2). The maximum salinity and the minimum temperature were recorded at slack water. Diurnal variations of tidal currents are shown in Figure 3. The current varied from 0-4.8 knots.

A variety of substrates is evident at the stations. In general there is a gradient from sandy beaches with rock outcrops (i.e. Bound Rock which is on the exposed open coast) to sandy-muddy locations (i.e. at the mouth of the Estuary) to muddy and peat-like substrates (i.e. at the head of the tidal rivers). Only limited quantities of solid substrates (rock outcrops, boulders and breakwaters) are present in the Estuary.

There are pronounced seasonal fluctuations of sand levels on the open coast near Bound Rock, and the abrasive action of sand limits both the species diversity and biomass of algae. Even so there are many more species at Bound Rock than within the Estuary. The conspicuous vegetation at Bound Rock is composed of *Cladophora sericea, Enteromorpha intestinalis, Pseudendoclonium marinum, Ulva lactuca, Fucus distichus* ssp *distichus, F. vesiculosus, Petalonia fascia, Ralfsia verrucosa, Scytosiphon lomentaria, Ahnfeltia*

Figure 1. The Hampton-Seabrook Estuary lying between latitudes 42° 51′ 30″ to 42° 55′ 55″ north and longitudes 70° 49′ 30″ to 70° 51′ 30″ west within the townships of Hampton, Hampton Falls and Seabrook, New Hampshire. Note that all of the tidal waters enter and leave via the Hampton Harbor Inlet and that five rivers (Taylor, Hampton Falls, Hampton, Brown and Blackwater) as well as many smaller creeks and brooks are present within the Estuary. Dots with numbers show the stations.

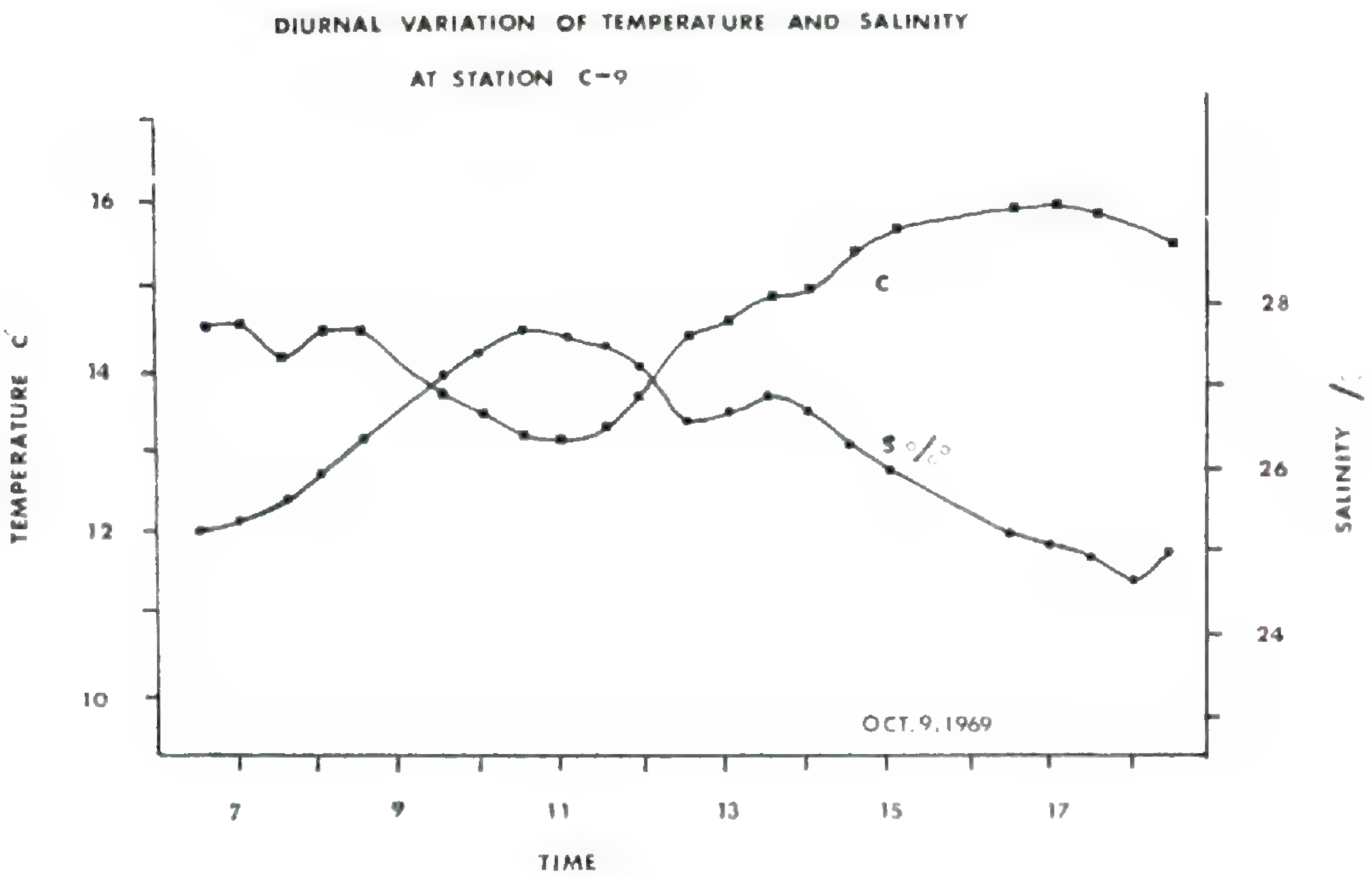

Figure 2. Diurnal variation of temperature and salinity at station C-9.

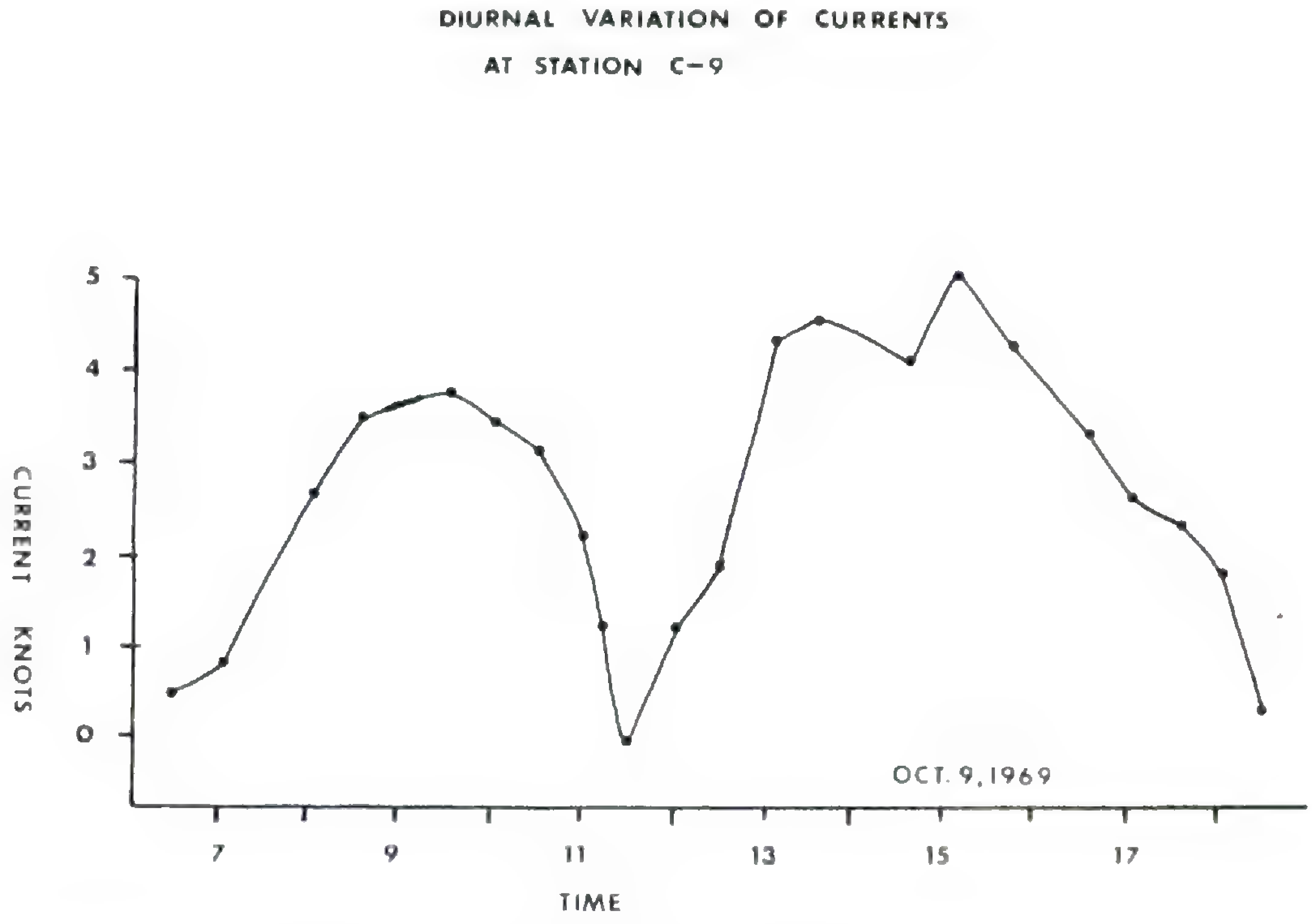

Figure 3. Diurnal variation of currents at station C-9.

plicata, Chondrus crispus, Corallina officinalis, Hildenbrandia prototypus and *Porphyra umbilicalis.* Some species (e.g. *Polyides rotundus* and *Ahnfeltia plicata*) are restricted to such sandy areas. Other plants which are not "sand loving" forms are often reduced in size, and they are only found in cracks and crevices. Several species are restricted to tide pools, which are somewhat protected from the fullest force of the sand and surf. *Fucus vesiculosus* dominates the eulittoral zone. *Ascophyllum nodosum* is conspicuously absent. Several common sublittoral species such as *Alaria esculenta, Laminaria saccharina, L. digitata* and *Desmarestia viridis* are rare at Bound Rock. However, they are present in greater abundance in the offshore rocks near Hampton Beach (station HB1-HB4 in Fig. 1).

A comparison of the common plants at Bound Rock with those of a "typical" estuarine site shows several differences. A variety of fucoid (*Ascophyllum nodosum, A. nodosum f. scorpioides* and *Fucus vesiculosus* var. *spiralis*) green (*Cladophora sericea, Enteromorpha erecta, E. intestinalis, Monostroma oxyspermum, Percursaria percursa, Rhizoclonium riparium* and *Ulva lactuca*), blue green (*Lyngbya* spp, *Oscillatoria* spp and *Gomphosphaeria* spp.) and yellow green algae (*Vaucheria* sp.) dominate the littoral zone. In addition *Spartina alterniflora, S. patens* and *Distichlis spicata* are abundant in the upper portion of the shore.

Results

A total of 118 taxa of benthonic marine algae was collected from the fifty-four stations, including 30 Chlorophyceae, 35 Phaeophyceae and 53 Rhodophyceae. A detailed examination of the Cyanophyceae, Bacillariophyceae and Xanthophyceae was beyond the scope of the present investigation. Table III summarizes the number of seaweed taxa found at each of the stations. The largest number of taxa was found at Bound Rock with fewer towards the head of the Estuary. Gross fluctuations of species numbers were recorded at different locations within the Estuary.

The following catalogue of Species includes some synony-

my, notes on collection sites and habitats and noteworthy taxonomic features. The occurence of each species is designated numerically as follows according to its habitat (Hehre and Mathieson, 1970; Mathieson, Hehre and Reynolds, in press; Mathieson, Reynolds and Hehre, in press):

#1 Coastal — restricted to the open coast
#2 Estuarine — restricted to the estuarine environment
#3 Cosmopolitan — present in both estuarine and open coastal environments.

Several of the cosmopolitan species may not occur in both habitats in the Hampton-Seabrook area, but they have been recorded from either the Great Bay Estuary or the open coast adjacent to Bound Rock.

List of Species

Chlorophyceae:

Blidingia marginata (J. Agardh) P. Dangeard:
equals *Enteromorpha marginata* J. Agardh in Taylor, 1957)
Found once on rocks in the lower eulittoral zone at Bound Rock. #3

Blidingia minima (Nägeli ex Kützing) Kylin:
(equals *Enteromorpha minima* Nägeli in Taylor, 1957)
Found once in the estuary (B9) on a muddy bank in the upper littoral zone. Abundant on the exposed open coast (Bound Rock) where it forms fringe zones. #3

Bryopsis plumosa (Hudson) C. Agardh
Locally abundant in the estuary (A3, A5, A9, A15, A17, B1, B2, B4 to B6, B8, and H3) on muddy surfaces in the sublittoral and lower eulittoral zones. Not found on the open coast. #2

Chaetomorpha aerea (Dillwyn) Kützing:
Collected three times from the lower eulittoral (in tide pools) at Bound Rock. #1

Chaetomorpha linum (O. F. Muller) Kützing:
(including *Chaetomorpha atrovirens* Taylor, in Taylor, 1957)

According to our interpretation *C. atrovirens* and *C. linum* are not distinct for there is a continuous gradient of size and color between the two. *Chaetomorpha linum* is the older name and it should be retained. The plant is common as an entangled mass amongst various algae in the lower eulittoral and sublittoral zones of the estuary (A2, A11, A18, B1, B2, B4 to B6, B9, B10, B12, C1, C2, C6, C7, and C9) and the exposed open coast (Bound Rock, HB1 and HB4). #3

Chaetomorpha melagonium (Weber *et* Mohr) Kützing:
Occasional on rocks in the lower eulittoral and sublittoral zones of the exposed open coast (Bound Rock, HB1 and HB4). #3

Cladophora sericea (Hudson) Kützing sensu van den Hoek, 1963:
Locally abundant in high tide pools in the estuary (A6, A7, A9, A10, B3, B7, B10, B12, C3 to C5, and H3) and on the exposed open coast (Bound Rock). #3

Codiolum pusillum (Lyngbye) Kjellman in Foslie:
Locally abundant on rocks in the upper littoral zone of the exposed open coast (Bound Rock). Often mixed with *Bangia fuscopurpurea* and various blue green algae. It may be the sporophyte stage of one or more local species of *Urospora* (Scagel, 1966). #1

Enteromoprpha compressa (L.) Greville:
Found once on rocks in the lower eulittoral zone at Bound Rock. #3

Enteromorpha erecta (Lyngbye) J. Agardh:
Abundant on muddy surfaces of the eulittoral zone throughout the estuary (A1 to A9, A13, A14, A16, A17, B1 to B7, B9, B13, C1 to C6, H1 and H3); occasionally present as an epiphyte on fucoid algae and *Spartina alterniflora*. Uncommon on the exposed open coast (Bound Rock). #3

Enteromorpha intestinalis (L.) Link:
Common on rocks and muddy surfaces of the eulittoral zone throughout the estuary (A1, A2, A4, A6 to A10, A13, A17, B1 to B5, B8, C1, C3, C5 to C7, C9, and H3) and on the open coast (Bound Rock). #3

Enteromorpha linza (L.) J. Agardh:
Found sporadically in the estuary (C9 and H1) and the exposed open coast (Bound Rock and HB1); present on mud, rocks and as an epiphyte in the lower eulittoral and upper sublittoral zones. #3

Enteromorpha plumosa Kützing:
Found twice in the estuary (A18 and B12) on muddy surfaces in the lower eulittoral zone. #3

Enteromorpha prolifera (O. F. Müller) J. Agardh:
Infrequent in the estuary (B2, C2, C3, C5, C6 and C11); present on muddy surfaces of the eulittoral zone. Mixed with *Enteromorpha erecta* but never occurring as abundantly. #3

Monostroma fuscum (Postels *et* Ruprecht) Wittrock:
Found sporadically throughout the estuary (A15, B2, B4, B6, B8, C1 and C3) on mud and rocks in the lower eulittoral and sublittoral zones. Abundant in localized areas on the exposed open coast (Bound Rock and HB4), and with the same vertical distribution. #3

Monostroma grevillei (Thuret) Wittrock:
Infrequent on rocks in the mid and lower eulittoral zones of the estuary (A5, A15, B6 and B10). Abundant on the exposed open coast (Bound Rock) and with the same vertical distribution. #3

Monostroma leptodermum Kjellman:
Found once adrift at A3. #3

**Monostroma oxyspermum* (Kützing) Doty:
Locally abundant throughout the estuary (A2 to A4, A9, B1, B4, B6, B8, C1, C2, and C4 to C7) — particularly in areas of low salinity. It forms a distinct band on high vertical (muddy) banks and occasionally occurs as an epiphyte on *Spartina alterniflora* and other vascular plants. #2

Monostroma pulchrum Farlow:
Common (during the summer) on rocks and on various algae in the lower eulittoral and sublittoral zones of the exposed open coast (Bound Rock). #3

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*Within range but not previously recorded for New Hampshire.

Percursaria percursa (C. Agardh) Rosenvinge:
Locally abundant in the estuary (A1, A2, A16, B1, B3, B6, B7, and C3 to C5) as free-floating masses in tide pools and attached to muddy surfaces in the upper eulittoral zone. Often mixed with *Rhizoclonium riparium* and *Cladophora sericea*. #3

Pseudendoclonium marinum (Reinke) Aleem *et* Schulz:
(equals *Protoderma marinum* Reinke in Taylor, 1957)
Abundant on rocks from the mid eulittoral to the sublittoral zones on the exposed open coast (Bound Rock); found once in the estuary (A11). #3

Rhizoclonium riparium (Roth) Harvey:
Abundant throughout the estuary (A1 to A5, A7 to A9, A15, B1 to B4, B6, B8 to B10, B11 to B13, C1 to C6, C8, C10, C11, and H3) as free floating masses in tide pools and attached to muddy surfaces in the upper littoral zone. Often mixed with *Cladophora sericea* and *Percursaria percursa*. #3

Rhizoclonium tortuosum Kützing:
Abundant during the summer on the exposed open coast (Bound Rock); found once in the estuary (C9). Present as entangled masses amongst various algae (particularly *Chondrus crispus* and *Gigartina stellata*) in the lower eulittoral and sublittoral zones. #3

Spongomorpha arcta (Dillwyn) Kützing:
Abundant on rocks (rarely as an epiphyte) in the mid-lower eulittoral zones of the exposed open coast (Bound Rock); most conspicuous in the late winter and spring. #3

Spongomorpha spinescens Kützing:
Abundant on rocks in the mid to lower eulittoral zones of the exposed open coast (Bound Rock); most conspicuous in the spring and summer. #3

Ulothrix flacca (Dillwyn) Thuret in Le Jolis:
Locally abundant (during winter and spring) on rocks in the upper littoral zone of the exposed open coast (Bound Rock). #3

Ulva lactuca L:
Ubiquitous throughout the estuary (being found at all stations except A6, A11, A15, A16, C8, D2, D3, H2, and H4) on mud and any solid substrates in the lower eulittoral and sublittoral zones. Present on the exposed open coast (Bound Rock and HB2 and HB4) but not as abundant as in the estuary. #3

Urospora collabens (C. Agardh) Holmes *et* Batters:
Locally abundant (particularly during the winter and spring) on rocks in the upper littoral zone at Bound Rock. #3

Urospora penicilliformis (Roth) Areschoug:
The abundance and distribution (both seasonal and vertical) of this species is essentially similar to that of *U. collabens* — except that it tends to appear later than *U. collabens.* #3

Urospora speciosa (Carmichael *ex* Harvey in Hooker) *Leblond et* Hamel:
Occasional (particularly during the winter and spring) on rocks in the upper littoral zone at Bound Rock. #1

Phaeophyceae:

Agarum cribrosum (Mertens) Bory:
Common on rocks in the sublittoral zone of the exposed open coast (Bound Rock, HB1, HB3, and HB4); not found in the estuary. #1

Alaria esculenta (L.) Greville:
Locally abundant on rocks in the sublittoral zone of the exposed open coast (Bound Rock, HB2 and HB3); not found in the estuary. #1

Ascophyllum nodosum (L.) Le Jolis:
Common throughout the estuary (A2, A4, A11, A13, A14, A17, A18, B1, B2, B9, B10, C1 to C4, C10 and C11 and H3) on any solid substrate from the upper sublittoral to the mid eulittoral zones. It is a rare plant on the exposed open coast at Bound Rock. #3

Ascophyllum nodosum (L.) Le Jolis f. *scorpioides* (Hornemann) Reinke:

Common on high muddy banks throughout the estuary (A1 to A3, A5 to A7, A12 to A14, A17, B1 to B3, B5, B6, B8, B9, B13, C1 to C3, C5, C6, C11, D2 and D3) ; entangled amongst *Spartina alterniflora* and other vascular plants. #2

Chorda filum (L) Stackhouse:
Found once on pier pilings in the estuary (H3) ; another time on rocks and shells on the exposed open coast (Bound Rock). In both cases the plants were present in the sublittoral zone. #3

Chorda tomentosa Lyngbye:
Locally abundant (during the summer) on scattered rocks in the sublittoral zone of the exposed open coast (Bound Rock and HB3). #3

Chordaria flagelliformis (O. F. Müller) C. Agardh:
Found twice in the estuary (H1 and H3) ; in both cases it was growing on pier pilings in the lower eulittoral — sublittoral zones. The plant is common (during the summer) on the exposed open coast (Bound Rock and HB2) and has the same vertical distribution as in the estuary. #3

Desmarestia aculeata (L.) Lamouroux:
Common on rocks in the sublittoral zone of the exposed open coast (Bound Rock, HB2 to HB4). #1

Desmarestia viridis (O. F. Müller) Lamouroux:
Occasional on rocks in the sublittoral zone of the exposed open coast (Bound Rock, HB1, HB3 and HB4). #1

Dictyosiphon foeniculaceus (Hudson) Greville:
Found once on mud covered rocks in the lower eulittoral zone of the estuary (C5). #3

Ectocarpus confervoides (Roth) Le Jolis:
(equals *E. siliculosus* (Dillwyn) Lyngbye in Parke and Dixon, 1968)
Occasional on rocks and larger algae in the eulittoral and sublittoral zones of the estuary (A14, A17, B9, C9 to C11 and H1) and the exposed open coast (Bound Rock, HB1 to HB4). The estuarine plants were more robust in stature than the plants from the open coast. #3

Ectocarpus siliculosus (Dillwyn) Lyngbye:
Found once as an epiphyte on *Spartina alterniflora* in the upper littoral zone of the estuary (C5). #3

Elachista fucicola (Velley) Areschoug:
An occasional epiphyte on *Ascophyllum nodosum* and *Fucus vesiculosus* var *spiralis* in the estuary (A1, B12, C1, C3, C5 and H3); very common on *Fucus vesiculosus* on the exposed open coast (Bound Rock and HB2). #3

Fucus distichus (L.) emend Powell subsp. *distichus* Powell:
Locally abundant in high tide pools of the exposed open coast (Bound Rock). #1

Fucus distichus (L.) emend Powell subsp. *edentatus* (De la Pylaie) Powell:
Common on rocks in the lower eulittoral — sublittoral zones of the exposed open coast (Bound Rock and HB2). Found once in a similar habitat near the mouth of the estuary (H1). #3

Fucus distichus (L.) emend. Powell subsp. *evanescens* (C. Agardh) Powell:
Locally abundant on rocks in the lower eulittoral — sublittoral zones of the exposed open coast (Bound Rock). #3

Fucus vesiculosus L:
Abundant on semi-exposed rocks from the mid to the lower eulittoral at Bound Rock. #3

Fucus vesiculosus L. var *spiralis* Farlow:
Ubiquitous throughout the estuary (at all stations except A12, A15, A16, C8, H1, H2 and H4) on mud, rocks, shells and any other solid substrates in the mid to the upper eulittoral zone. It is one of the most conspicuous species on the upper banks of the salt marshes, where it is associated with *Ascophyllum nodosum* f. *scorpioides*, *Spartina alterniflora* and various other vascular plants. #2

Giffordia granulosa (J. E. Smith) Hamel:
Found once in the estuary (A7) on mud-covered rocks in the lower eulittoral zone. #2

Laminaria digitata (Hudson) Lamouroux:
Present on rocky substrate in the sublittoral zone of the exposed open coast (Bound Rock, HB1, HB3 and HB4) and at the mouth of the estuary (H1). Each specimen had a consistent +– anatomy (i.e. mucilage ducts are present in the blade and absent from the stipe, Wilce, 1965). #3

Laminaria saccharina (L.) Lamouroux sensu Wilce, 1965:
Its distribution was essentially similar to that of *L. digitata* except that it was found at one other coastal (HB2) and estuarine location (A18). All of the specimens were the –– ecotype of Wilce, 1965 (i.e. *L. agardhii* Kjellman in Taylor, 1957). #3

Leathesia difformis (L.) Areschoug:
A common epiphyte (during the summer) on *Chondrus crispus* and other algae in the lower eulittoral-upper sublittoral zones of the exposed open coast (Bound Rock and HB2). #1

Petalonia fascia (O. F. Müller) Kuntze:
Common throughout the estuary (A4, A5, A7, A9, A14, A15, A17, B2, B4, B6, B10, B13, C2, C6, C11, D2 and D3) and on the exposed open coast (Bound Rock). It is present in the eulittoral zone on rocks (often in tide pools), mud, and occasionally as an epiphyte on large algae. #3

Pilaiella littoralis (L.) Kjellman:
Common on rocks and as an epiphyte on *Fucus vesiculosus* in the mid-lower eulittoral zones of the exposed open coast (Bound Rock). Occasionally present in the estuary (C1, C5 and C6) and with the same vertical distribution. #3

**Pseudolithoderma extensum* (Crouan frat.) S. Lund:
(equals *Lithoderma extensum* (Crouan) Hamel in Taylor, 1957)
Occasional on sublittoral stones and boulders of the exposed open coast (HB2 and HB4). #1

Ralfsia borneti Kuckuck:
Occasional on stones and boulders in the lower eulittoral – sublittoral zones of the estuary (A8, A10, B10, B11, and C1). According to Edelstein, Chen and McLachlan (1970)

R. borneti is a stage in the life history of *Petalonia fascia*, and it is not a valid taxa. #3

Ralfsia clavata (Harvey in Hooker) Crouan frat.:
Found once in the estuary (A-8) on mud covered rocks in the lower eulittoral zone. It is also described (Edelstein, Chen and McLachlan, 1970) as a stage in the life history of *Petalonia fascia*. #3

Ralfsia fungiformis (Gunner) Setchell *et* Gardner:
Found once on rocks in the sublittoral zone of the exposed open coast (HB4). #1

Ralfsia verrucosa (Areschoug) J. Agardh:
Found twice on rocks and shells in the upper sublittoral and eulittoral zones of the estuary (B3 and C1). Abundant in the same zones on the exposed open coast (Bound Rock). #3

Saccorhiza dermatodea (De la Pylaie) J. Agardh:
Occasional on rocks in the sublittoral zone of the exposed open coast (HB1 and HB3). #1

Scytosiphon lomentaria (Lyngbye) Link:
Present on rocks (often in tide pools), mussels shells, mud and occasionally epiphytic on various plants in the eulittoral zone of the estuary (A5, A14, A15, A17, B1, B2, B4, B10, C9, C11 and D3) and the exposed open coast (Bound Rock). #3

***Sorapion kjellmanii* (Wille) Rosenvinge:
Found once on rocks in the sublittoral zone of the exposed open coast (HB2). #1

***Sphacelaria plumosa* Lyngbye:
(equals *Chaetopteris plumosa* (Lyngbye) Kützing in Taylor, 1957)
Occasional on sand covered rocks in the mid-lower sublittoral zone of the exposed open coast (HB1). #1

Sphacelaria radicans (Dillwyn) C. Agardh:
Occasional on muddy or sandy surfaces in the mid-lower eulittoral zone of the estuary (A9, B1 and B10); also

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**Range extension and a new record for New Hampshire.

present on sand covered rocks in the sublittoral zone of the exposed open coast (HB1, HB3 and HB4). #3

Spongonema tomentosum (Hudson) Kützing:
(equals *Ectocarpus tomentosus* (Hudson) Lyngbye in Taylor, 1957)
Found once as an epiphyte on *Laminaria saccharina* in the sublittoral zone of the exposed open coast (HB3). #1

Rhodophyceae:

Ahnfeltia plicata (Hudson) Fries:
Locally abundant on sand-covered rocks and boulders in the lower eulittoral – sublittoral zones of the exposed open coast (Bound Rock, HB1, HB2 and HB4). #3

Antithamnion floccosum (O. F. Müller) Kleen:
Found once on sand covered rocks in the sublittoral zone of the exposed open coast (HB3). #3

Audouinella membranaceae (Magnus) Papenfuss:
Epiphytic on species of *Sertularia* which in turn may be epiphytic (commonly on fucoid algae) or saxicolous in the eulittoral zone of the exposed open coast (Bound Rock). #3

**Asterocytis ramosa* (Thwaites in Harvey) Gobi *ex* Schmitz:
Found once as an epiphyte on *Cladophora sericea* in a high marshy tide pool (C4). Growing in association with *Percursaria percursa* and various blue green algae. #2

Bangia ciliaris Carmichael:
Found once as an epiphyte on *Cladophora sericea* in a high marshy tide pool (C5) in the estuary. #3

Bangia fuscopurpurea (Dillwyn) Lyngbye:
Abundant (particularly during the winter and spring) on rocks in the upper littoral zone of the exposed open coast (Bound Rock). #3

Callithamnion baileyi Harvey:
Found once in the estuary (H3) on a styrofoam float. #3

Callithamnion corymbosum (J. E. Smith) C. Agardh:
Found once in the estuary (A17) on rocks in the upper sublittoral zone. #2

Ceramium rubrum (Hudson) C. Agardh:
Present on rocks and epiphytic on large macroscopic algae in the lower eulittoral and sublittoral zones. Occasional within the estuary (B1 to B3, B7, C2, C5, and H3), but more abundant on the exposed open coast (Bound Rock, HB1 to HB4). #3

Ceramium strictum Harvey:
Abundant throughout the estuary (A1 to A4, A7, A8, A10, A12, A17, B1 to B6, B9, C1, C3 to C7, C11 and H1) on muddy surfaces in the lower eulittoral – sublittoral zones. Uncommon on the exposed open coast (Bound Rock). #3

Chondrus crispus Stackhouse:
Common throughout the estuary (A1 to A3, A5, A9 to A15, A17, A18, B2, B4 to B6, B8 to B11, C1, C9, C11, D3 and H1) and the exposed open coast (Bound Rock, HB2 to HB4); present on any solid substrate in the lower eulittoral and sublittoral zones. The stature of the estuarine plants is much larger than the plants from the open coast. #3

Clathromorphum circumscriptum (Strömfelt) Foslie:
(equals *Phymatolithon compactum* (Kjellman) Foslie in Taylor, 1957)
Abundant on rocks and shells in the lower eulittoral and sublittoral zones of the exposed open coast (Bound Rock, HB1 to HB4). Found once in the estuary (A10) on a subtidal population of mussels. #3

Corallina officinalis L.:
Locally abundant on rocks and boulders (often in tide pools) in the eulittoral and sublittoral zones of the exposed open coast (Bound Rock, HB1 to HB4). #1

Cystoclonium purpureum (Hudson) Batters var. *cirrhosum* Harvey:
Present on rocks and as an epiphyte on larger algae in the sublittoral zone of the exposed open coast (Bound Rock, HB1 to HB4). #3

Dermatolithon pustulatum (Lamouroux) Foslie:

(equals *Lithophyllum pustulatum* (Lamouroux) Foslie in Taylor, 1957)

An occasional epiphyte on various algae (particularly *Chondrus crispus* and *Gigartina stellata*) in the lower eulittoral-sublittoral zones of the exposed open coast (Bound Rock, HB2 and HB4). #3

Dumontia incrassata (O. F. Müller) Lamouroux:
Abundant on rocks in the mid and lower eulittoral zones of the exposed coast (Bound Rock). Occasional throughout the estuary (A5, A14, A15, A17, A18, B6, B10, and D3) and with the same vertical distribution as on the open coast. #3

Euthora cristata (C. Agardh) J. Agardh:
Present on rocks and occasionally epiphytic on various plants (e.g. *Phyllophora* spp.) in the sublittoral zone of the exposed open coast (Bound Rock, HB1, HB3 and HB4). #1

Gigartina stellata (Stackhouse) Batters:
On rocks in the lower eulittoral and sublittoral fringe zones of the exposed open coast (Bound Rock). #3

Gloiosiphonia capillaris (Hudson) Carmichael *ex* Berkeley:
Found twice on rocks in the sublittoral zone of the exposed open coast (HB1 and HB4). #3

Hildenbrandia prototypus Nardo:
Common on rocks in the eulittoral and sublittoral zones of the exposed open coast (Bound Rock and HB2). Less common in the estuary (A8, A10, A11 and B10) but with the same vertical distribution. #3

Kylinia secundata (Lyngbye) Papenfuss:
A common epiphyte on various algae in the eulittoral zone of the exposed open coast (Bound Rock). #3

Lithophyllum corallinae (Crouan frat.) Heydrich:
Found once in the sublittoral zone of the exposed open coast (HB4); a specific epiphyte on *Corallina officinalis*. #1

Lithothamnium glaciale Kjellman:
Common on shells and rocks (often in tide pools) in the

lower eulittoral and sublittoral zones of the exposed open coast (Bound Rock, HB1 to HB4). #1

Melobesia lejolisii Rosanoff:
(equals *Fosliella lejolisii* (Rosanoff) Howe in Taylor, 1957)
An occasional epiphyte on *Phyllophora* spp. in the sublittoral zone of the exposed open coast (Bound Rock and HB3). #3

Membranoptera alata (Hudson) Stackhouse:
A common epiphyte on various algae (occasionally on rock) in the sublittoral zone of the exposed open coast (Bound Rock, HB1, HB3 and HB4). #1

Nemalion helminthoides (Velley in Withering) Batters:
Uncommon on rocks in the lower eulittoral zone of the exposed open coast (Bound Rock). #1

Petrocelis middendorfii (Ruprecht) Kjellman:
Present on rocks and shells in the sublittoral zone of the exposed open coast (HB2 and HB4). #3

Peyssonelia rosenvingii (Schmity in Rosenvinge):
Occasional on rocks in the sublittoral zone of the exposed open coast (HB1 and HB4). #1

Phycodrys rubens (L.) Batters:
Common on rocks and as an epiphyte on various algae in the lowest eulittoral and sublittoral zones of the exposed open coast (Bound Rock, HB1, HB3 and HB4) and at the mouth of the estuary (H1). #3

Phyllophora brodiaei (Turner) Endlich:
Common on rocks in the sublittoral zone of the exposed open coast (Bound Rock, HB1 to HB4). #1

Phyllophora membranifolia (Goodenough *et* Woodward) J. Agardh:
The vertical and horizontal distribution of *P. membranifolia* is essentially similar to that of *P. brodiaei*. It was found at stations HB2, HB3 and Bound Rock. #3

**Phymatolithon laevigatum* (Foslie) Foslie:
Present on rocks and shells in the sublittoral zone of the exposed open coast (HB2 to HB4). #1

Phymatolithon lenormandi (Areschoug) Adey:
Present on rocks in the sublittoral zone of the exposed open coast (HB4). #3

Plumaria elegans (Bonnemaison) Schmitz:
Common on vertical rock faces under overhanging fucoids in the lower eulittoral zone of the exposed open coast (Bound Rock). It was found once in the estuary (A14) with the same vertical distribution. #3

Polyides rotundus (Hudson) Greville:
Occasional on sand covered rocks in the sublittoral zone of the exposed open coast (Bound Rock, HB2 to HB4). #3

Polysiphonia denudata (Dillwyn) Greville *ex* Harvey in Hooker:
Found twice in the estuary (B6 and B10) on muddy surfaces in the sublittoral zone. #3

Polysiphonia elongata (Hudson) Sprengel:
Found twice in the sublittoral zone of the estuary (A7 and H3). #2

Polysiphonia fibrillosa (Dillwyn) Sprengel:
Common throughout the estuary (A1, A2, A4, A10, B2 to B6, C2, C4 to C6, C9 and H3) on muddy surfaces in the lower eulittoral and sublittoral zones. #2

Polysiphonia lanosa (L.) Tandy:
Hemiparasitic on *Ascophyllum nodosum* on the open coast (Bound Rock) and at the mouth of the estuary (A2 and A4). #3

Polysiphonia nigra (Hudson) Batters:
Present on rocks in the lower eulitoral-sublittoral zones of the estuary (A15, B2, B3, B6, B7 and H3) and the exposed open coast (Bound Rock). #3

Polysiphonia nigrescens (Hudson) Greville:
On rocks and shells in the lower eulittoral and sublittoral zones of the estuary (A4, A7, A11, A12, A15, B2, B4, B5, B10, C1, C2, C5, H1 and H3) and the exposed open coast (HB1 and HB4). #3

Polysiphonia novae-angliae Taylor:
Present on rocks in the sublittoral zone of the exposed open coast (Bound Rock, HB1 and HB2). #3

Polysiphonia subtilissima Montagne:
Found once in the estuary (A12) ; growing on mud in the lower eulittoral zone. #1

Polysiphonia urceolata (Lightfoot *ex* Dillwyn) Greville:
Common on rocks in the lower eulittoral and sublittoral zones of the exposed open coast (Bound Rock, HB1 to HB4). Found once in the estuary at (B6) with the same vertical distribution. #3

Porphyra miniata (C. Agardh) C. Agardh:
Common (particularly during the summer) on rocks and epiphytic on various plants in the upper sublittoral zone of the exposed open coast (HB1 to HB4). #3

Porphyra umbilicalis (L.) J. Agardh:
Common on rocks, mud and on various algae in the eulittoral zone of the estuary (A1, A3 to A5, A8, A12, A14, A17, C3, C5, C6, C9, H1 and H3) and the exposed open coast (Bound Rock). #3 The forma *epiphytica* Collins was only found at Bound Rock. #3

Ptilota serrata Kützing:
Present on rocks and epiphytic on various algae in the sublittoral zone of the exposed open coast (Bound Rock, HB1 and HB3). #1

Rhodochorton purpureum (Lightfoot) Rosenvinge:
Present on vertical rock faces under overhanging fucoids in the midlower eulittoral zone of the exposed open coast (Bound Rock). #3

**Rhodophysema elegans* (Crouan frat. *ex* J. Agardh) Dixon: (equals *Rhododermis elegans* Crouan in Taylor, 1957)
Occasional on rocks and shells in the sublittoral zone of the exposed open coast (HB2 and HB4). #1

Rhodomela confervoides (Hudson) Silva:
Locally abundant on sand-covered rocks in the lower eulit-

toral and sublittoral zones of the exposed open coast (Bound Rock, HB1 and HB3). #1

Rhodophyllis dichotoma (Lepeschkin) Gobi:
Found once adrift at Bound Rock. #1

Rhodymenia palmata (L.) Greville:
Relatively common on rocks and various algae (particularly *Laminaria* spp.) in the sublittoral zone of the exposed open coast (Bound Rock, HB1 to HB4) and the mouth of the estuary (H1). #3

DISCUSSION

Eight of the taxa of marine algae recorded in the present study represent new records for the state of New Hampshire (*Monostroma oxyspermum, Asterocytis ramosa, Phymatolithon laevigatum, Polysiphonia fibrillosa, Rhodophysema elegans, Pseudolithoderma extensum, Sorapion kjellmanii* and *Sphacelaria plumosa*). *Sorapion kjellmanii* and *Sphacelaria plumosa* also represent extensions of known distributional range on the northeast coast of North America, for they were both previously recorded from Ellesmere Island to Nova Scotia (as summarized in Taylor, 1957 and Cardinal, 1968). It should be noted that both species were collected in the mid-lower sublittoral zones of the open coast.

The primary factors restricting the growth and distribution of seaweeds in the Hampton-Seabrook Estuary are a lack of stable substrate and adverse hydrographic conditions. As a consequence gross fluctuations of species numbers occurred at different locations, and a gradual reduction in species diversity and biomass was evident from the open coast to the head of the estuary. Green algae showed the widest distribution throughout the estuary, for they grew on a variety of substrates and in a wide range of temperatures and salinities.

A greater diversity and biomass of seaweeds were recorded in the Great Bay Estuary complex (Mathieson, Reynolds and Hehre, in press) than in the Hampton-

Seabrook Estuary. Thus, 98 taxa of algae were found in the former area, while only 57 were found in the latter. The variety of species found in the estuarine environments of Great Bay is primarily due to its large size (over 15,000 acres of tidewater) and its greater variety of habitats (particularly tidal rapids) and substrates. Peak populations of seaweeds were found at Dover Point and Adams Point in the Great Bay System (Mathieson, Reynolds and Hehre, in press). Both of the sites are exposed to strong tidal currents and their floras are "open coastal" in nature. More than half of the 76 cosmopolitan species found in the Great Bay area were either restricted to the two tidal rapid sites or they did not extend inland beyond Dover Point or Adams Point. Only one major tidal rapid was observed in the Hampton-Seabrook area (station C-9), and it was so shaded that few algae grew there. The discrepancy in species numbers between the two estuaries is primarily accounted for by the cosmopolitan component of Great Bay.

All of the species found in the Hampton-Seabrook Estuary, except *Monostroma oxyspermum, Chorda filum, Dictyosiphon foeniculaceus, Elachista fucicola, Ralfsia borneti, R. clavata, Sphacelaria radicans, Asterocytis ramosa, Plumaria elegans* and *Polysiphonia fibrillosa,* were also found in the Great Bay area. The occurrence of *P. elegans* and *S. radicans* in estuarine waters was particularly striking, for both of the species are most abundant on the open coast.

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Table I

Stations

A- 1	At the mouth of the first major tributary SE of Tide Mill Creek on the Hampton River, Hampton Falls, Hampton, N. H.* (1.3 miles inland)
A- 2	The northeast portion of an "island" formed at the mouth of the Taylor River, Blind Creek and the upper part of the Hampton River, Hampton Falls, Hampton, N. H. (1.91 miles inland)
A- 3	Approximately 1500 feet NE of the mouth of Tide Mill Creek and the Hampton River, Hampton, N. H. (1.3 miles inland)
A- 4	Approximately 1800 feet NW of Station A-2 on the Hampton River, Hampton-Hampton Falls, N. H. (2.3 miles inland)
A- 5	Opposite a small brook, which empties into the first tributary above the mouth of the Hampton Falls River, Hampton, N. H. (3.3 miles inland)
A- 6	At the junction of the first oxbow NE of station A-5 on the Taylor River, Hampton, N. H. (3.2 miles inland)
A- 7	Hampton Landing on the Taylor River, Hampton, N. H. (3.1 miles inland)
A- 8	At the mouth of Nudds Canal and Blind Creek, Hampton, N. H. (2.31 miles inland)
A- 9	Tide Mill Creek, by the route 101 bridge, Hampton, N. H. (2.56 miles inland)
A-10	Hampton Falls River south of Depot Avenue and near the Boston and Maine Railroad bridge, Hampton Falls, N. H. (5.2 miles inland)
A-11	Approximately 2000 feet SW of the Boston and Maine "sub-station" which is between Lafayette and Landing Roads. Station A-11 is adjacent to the B & M railroad tracks, and on the Taylor River, Hampton, N. H. (4.4 miles inland)
A-12	End of Depot Avenue on the Hampton Falls River, Hampton Falls, N. H. (5.0 miles inland)
A-13	Middle of the southernmost oxbow near the mouth of the Taylor River and the Hampton Town Line, Hampton, N. H. (3.0 miles inland)
A-14	A bend in the first tributary above (north) the Hampton Falls River where the river crosses the railroad tracks, Hampton, N. H. (3.7 miles inland)
A-15	Same as A-14, except the land side of the railroad tracks, rather than the harbor side as A-13, Hampton, N. H. (3.7 miles inland)

* Distance inland from exposed open coast

A-16 A salt marsh on a point of land made by the Hampton River and the first tributary above the Hampton Falls River, Hampton, N. H. (3.5 miles inland)

A-17 Hampton Landing, Taylor River, Hampton, N. H. (3.01 miles inland)

A-18 The Willows; at the mouth of Tide Mill Creek and the Hampton River, Hampton, N. H. (1.6 miles inland)

B- 1 On a small "island" opposite Eastman's Slough and about 2500 feet west of Locke Point State Park area, Hampton Falls, Seabrook, N. H. (1.0 miles inland)

B- 2 The southernmost portion of Eastman Slough, near Halftide Rock and at the mouth of the Brown River, Hampton Falls-Seabrook, N. H. (1.7 miles inland)

B- 3 Just inside the mouth of Hunts Island Creek and at the junction of the Brown River, Seabrook, N. H. (1.8 miles inland)

B- 4 Approximately 500 feet NW of the first tributary past Hunts Island Creek, Hampton Falls-Seabrook, N. H. (2.0 miles inland)

B- 5 Approximately 700 feet NE of the mouth of Swain's Creek, Hampton Falls, N. H. (2.2 miles inland)

B- 6 Robbins Point, Hampton Flats, Hampton Falls-Seabrook, N. H. (2.3 miles inland)

B- 7 Browns River, first tributary upstream from Swain's Creek, Hampton Falls, N. H. (2.5 miles inland)

B- 8 Approximately 800 feet upstream from Robbins Point, Hampton Falls, N. H. (2.4 miles inland)

B- 9 Approximately 700 feet upstream from station B-8, Hampton Falls-Seabrook, N. H. (2.53 miles inland)

B-10 End of Rocks Road, on the Browns River, Hampton Falls-Seabrook, N. H. (2.8 miles inland)

B-11 Near the mouth of the first major tributary east of the head waters of the Browns River, Hampton Falls-Seabrook, N. H. (3.0 miles inland)

B-12 Approximately 1500 feet upstream (west) from station B-11, just before a major oxbow, Hampton Falls-Seabrook, N. H. (3.3 miles inland)

B-13 Swain's Creek, neck of the first oxbow, Hampton Flats, Hampton Falls, N. H. (2.6 miles inland)

C- 1 At the mouth of the Blackwater River; near the first tributary SW of Mills Point, Seabrook, N. H. (1.5 miles inland)

C- 2 Approximately 1200 feet SW of the first tributary past Riverside, Seabrook, N. H. (2.2 miles inland)

C- 3 Approximately 1200 feet south of C-2, Seabrook, N. H. (2.3 miles inland)

C- 4 Approximately 500 feet SE of C-3, Seabrook, N. H. (2.4 miles inland)

C- 5 Approximately 800 feet SE of C-4, Seabrook, N. H. (2.5 miles inland)

C- 6 Approximately 800 feet SE of C-5 and near the first tributary southeast of C-2, Seabrook, N. H. (2.7 miles inland)

C- 7 Approximately 1200 feet SE of C-6 and near a large white rock, Seabrook, N. H. (3.0 miles inland)

C- 8 Approximately 1500 feet SE of C-7, Seabrook, N. H. (3.3 miles inland)

C- 9 By the route 286 bridge which crosses the Blackwater River, Seabrook, N. H. (3.6 miles inland)

C-10 Mills Point — mouth of the Blackwater River, Seabrook, N. H. (1.3 miles inland)

C-11 Riverside, Seabrook, N. H. (1.7 miles inland)

D- 1 At the mouth of the creek between Knowles Island and mainland, Seabrook, N. H. (1.34 miles inland)

D- 2 Before the first bend near the mouth of Mill Creek, Seabrook, N. H. (1.6 miles inland)

D- 3 Walton Landing, end of Walton Road, Seabrook, N. H. (2.1 miles inland)

H- 1 At the junction of the middle piling of the toll bridge in Hampton Harbor and the tower at Hampton, N. H. (0.4 miles inland)

H- 2 In the channel of Hampton Harbor near the mouth of the Blackwater River and at the junction of the imaginary line between the Seabrook Marina and Knowles Island, Seabrook, N. H. (1.0 miles inland)

H- 3 Smith and Gilmore Marina, Hampton, N. H. (0.8 miles inland)

H- 4 Hampton Marina — mouth of Hampton River, Hampton, N. H. (0.97 miles inland)

HB-Bound Rock The area in the immediate vicinity of Beckman's Point, which is near the mouth of Hampton Harbor, Hampton, N. H. Exposed open coast.

HB-1 A series of offshore rocks in the immediate proximity of the red marker flag, and in 35-40 feet of water, Hampton, N. H. Exposed open coast

HB-2 The southernmost rock outcrop (a rookery) before the Hampton Breakwater; in 15-20 feet of water and the sheltered side, Hampton, N. H. Exposed open coast.

HB-3 The exposed (seaward) side of the same rock outcrop as HB-2; 30-40 feet of water, Hampton, N. H. Exposed open coast.

HB-4 The southernmost outcrop which is opposite the Hampton State Beach Park Breakwater; in 20-25 feet of water, Hampton, N. H. Exposed open coast.

Table II

Surface Water Temperatures and Salinities

Station	*Temperature* (C)	*Salinities* (0/00)	*Dates**
A1	16 - 20	31 - 33.0	
A2	19 - 19.5	31 - 31.5	
A3	16 - 20.5	31 - 32.0	
A4	19 - 20.8	31 - 32.0	
A5	18 - 21.5	31 - 31.3	
A6	20.5	32.0	
A7	20.5 - 29.5		
A8	15.0 - 19.8	30.5 - 32.0	
A9	(-1.0) - 22.5	20.2 - 30.0	12-21-69
A10	24.0	33.5	
A11	21.5	31.3	
A12	9.0 - 10.0	28.6 - 30.4	10-04-66
A13	8.0	27.4 - 27.6	11-18-66
A14	7.0	24.0	11-18-66
A15	8.0	23.9	11-18-66
A16	9.0	30.6	11-18-66
A17	0.0	24.7 - 24.9	11-13-66
A18	0.0	30.6 - 30.8	11-13-66
B1	16.0	26.3	
B2	17.0 - 18.0	22.8 - 30.9	
B3	17.0 - 19.0	30.5 - 30.9	
B4	16.5	30.5	
B5	16.0 - 16.5	24.4 - 30.3	
B6	2.0 - 17.0	20.7 - 29.9	12-06-69
B7	18.0	28.9	
B8	18.0	28.9	
B9	16.0 - 16.5	17.2 - 18.2	
B10	16.5 - 20.0	16.2 - 31.6	
B11	16.0 - 19.0	14.2 - 30.9	
B12	16.0 - 19.0	13.2 - 30.9	
B13	3.0	28.9	12-06-66
C1	15.0	29.4	
C2	15.5	28.5	
C3	15.5	25.6	
C4	15.0	26.0	
C5	15.5	25.2	
C6	15.5	25.2	
C7	15.5	25.6	

C8	15.5	24.5	
C9	13.2 - 16.2	11.5 - 14.5	10-09-69
C10	10.0	27.2	10-13-66
C11	11.0	26.8	10-22-66
D2	13.0	23.6	11-11-66
D3	13.0	20.2	11-11-66
H1	16.5	30.5	
H2	16.8	30.5	
H4	1.0	30.5	12-21-66
Bound Rock	0.0 - 19.0	29.5 - 32.0	7-18-66

* All dates from August and September, 1969 except those specified.

Table III. Number of Seaweed Taxa of Various Stations

Stations	*Total*	*Chlorophyceae*	*Phaeophyceae*	*Rhodophyceae*
A1	12	5	3	4
A2	14	7	3	4
A3	11	6	2	3
A4	13	5	3	5
A5	12	5	4	3
A6	5	3	2	—
A7	12	5	4	3
A8	10	4	3	3
A9	11	7	3	1
A10	11	3	3	5
A11	7	2	2	3
A12	7	1	1	5
A13	8	3	3	2
A14	12	2	6	4
A15	8	4	—	4
A16	2	2	—	—
A17	15	4	6	5
A18	8	3	3	2
B1	15	8	5	2
B2	19	8	5	6
B3	13	6	3	4
B4	15	8	3	4
B5	11	5	2	4
B6	19	9	3	7
B7	10	6	2	2
B8	7	4	1	2
B9	11	5	4	2
B10	16	5	6	5

B11	5	2	2	1
B12	7	5	2	—
B13	6	3	3	0
C1	17	7	7	3
C2	13	6	4	3
C3	14	8	4	2
C4	11	6	2	3
C5	19	8	5	6
C6	15	7	5	3
C7	6	4	1	1
C8	1	1	—	—
C9	10	5	2	3
C10	5	2	3	—
C11	11	3	6	2
D1	—	—	—	—
D2	4	—	4	—
D3	6	—	4	2
H1	14	3	5	6
H2	1	—	—	1
H3	18	6	5	7
H4	0	—	—	—
HB-Bound Rock	79	23	21	35
HB1	30	3	8	19
HB2	30	1	10	19
HB3	30	0	10	20
HB4	38	4	9	25

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EDGEWORTHIA (THYMELAEACEAE) NEW TO THE WESTERN HEMISPHERE

WILBUR H. DUNCAN AND MARIE MELLINGER

Edgeworthia chrysantha Lindl., a shrub previously known to be native only from eastern Asia, has been found growing wild in Rabun County in northeastern Georgia in the Blue Ridge Mountains. Plants were first observed 15 September 1971 by the junior author. They are now known to occur at intervals along 2.2 miles of Wolf Creek in deciduous woods at elevations of about 1200-1600 feet. The woods have had selective cutting but have never been cleared.

Many colonies of the *Edgeworthia* occur along Wolf Creek. One consists of at least 500 plants and extends along the banks of the stream for about 1/4 mile. The largest plant is 3.5 m tall and the stem 4 cm in diameter 15 cm above the ground. Plants vary in size, those on the stream bank being the most robust with smaller plants extending 6 m from the stream bank. Plants 75 cm or more tall usually bear inflorescences.

Open flowers were found on some plants on 26 February 1972. These flowers and vegetative material collected before frost enabled us to identify the plants positively to species. Specimens with full sized but immature fruits were collected 21 May 1972. All characteristics of the plants compare well with those of 23 specimens which we have seen from Japan. *Edgeworthia chrysantha* was introduced into Japan for cultivation as a source of paper and is now widely escaped there (Ohwi, 1965).

Is *Edgeworthia* native to the Southeastern States? We have found no reports to substantiate or repudiate such a theory. It is especially significant that neither Small (1933) nor Nevling (1962) reports the genus for this area. Apparently it has been reported as native only from China to Himalaya (Hooker, 1885; Nakai, 1924; Hamaya, 1955; Makino, 1957; Hutchinson, 1967). Fairchild (1903) reports the introduction of the species into the United States from Japan and later (1908) says that planting trials at Washington, D.C., and elsewhere indicate it will prove

hardy as far north as the Carolinas and will seed freely. Bailey and Bailey (1941) state that *E. chrysantha* "— is introduced in N. Amer." The Rabun County plants may be from one of these introductions, however, we have no data to indicate the species was introduced there or that it has escaped cultivation from elsewhere. Yet, it is incredible to think that the plants are an eastern Asiatic disjunct.

A few vascular plant species occur in both the Southeastern United States and China and/or Japan, e.g. *Mitchella repens* L. All are more widespread in both hemispheres than is the *Edgeworthia* in Rabun County. In addition, there are many genera in the Southeastern United States that have different species occurring in Asia, but no pair in any genus has the strong similarities as do our *Edgeworthia* plants and the 23 specimens we have seen from Japan. We are continuing our search for information which might indicate the Rabun County plants are introduced or escaped. If such data are lacking, then, because of the circumstances under which the plants are growing, we think the colony could be native. We solicit any information that might be of help.

Obviously descriptions of *E. chrysantha* are not readily available to most persons in the United States. Therefore, a short description is presented below along with a partial synonomy.

Edgeworthia chrysantha Lindl.

(*E. papyrifera* (Sieb.) Sieb. et Zucc., *E. tomentosa* (Thunb.) Nakai, *E. gardneri* of authors, not Meissner)

Deciduous shrub to 3.5 m tall, usually ternately branched. Twigs yellow-brown, appressed-pubescent when young. Leaf scars raised about 45° at the lower end, with one crescent-shaped bundle scar. Leaves petioled, the blades lanceolate to sometimes oblong; acute to shortly acuminate or rarely obtuse at the apex; cuneate to acuminate at the base; 8-25 cm long; thinly silky, especially below; the hairs .25-.75 mm long, appressed, and pointing toward the tip. Inflorescences are in axillary peduncled heads which develop before the leaves fall and are conspicuous during the winter.

Flowers fragrant, 20-50 in each head. Heads subtended by several densely silky ovate to oblong bracts which usually fall before the flowers open. The heads droop early, at least by the time that all flowers have opened. Flowers silky hairy on outside, apetalous, 10-18 mm long, the calyx lobes 2-3 mm long and yellow inside. Stamens 8 in two series of 4 on inside of floral tube, filaments very short. Ovulary nearly sessile, hairy, 1-locular. Styles 3-4 mm long. Stigma clavate. The entire pistil 7-9 mm long. The flowers open as early as late February. The fruits mature in summer. They are hairy at the apex, 6-7 mm long, ellipsoid to ovate, dry, green, and often surrounded by the somewhat persistent floral tube. Voucher specimens are in the University of Georgia Herbarium: *Mellinger*, 15 September 1971; *Duncan* 23751, 21 May 1972 (fruiting); in deciduous woods along Wolf Creek, Rabun Co., Georgia, Blue Ridge Province.

Edgeworthia as presently interpreted apparently consists of four species. They have been separated mostly on the basis of vestures or the lack of any, flower colors, and peduncle lengths. *E. longipes* Lace, which occurs in upper Burma, has peduncles 9-11 cm long. In other species they are only 1-2.5 cm long. *E. albiflora* Nakai, which occurs in Yunan and Szechwan Province, China, may be recognized by the whitish interior of the calyx and glabrous undersides of the leaves. In the remaining two species, *E. gardneri* Meisner and *E. chrysantha,* the leaves are hairy beneath (sometimes faintly so) and the flowers are yellow inside. The flowers appear with the leaves in the former and before the leaves in the latter. A much more reliable character apparently has not been used previously; the involucral bracts are ovate to oblong in *E. chrysantha* and linear (up to 35 mm long) in *E. gardneri.* There seems to be a short-bracted and a long-bracted form of *E. gardneri.* These forms may deserve taxonomic recognition and should be studied. The long-bracted form occurs from Nepal into northern Burma, and the short-bracted form from eastern Nepal into southwestern China. *Edgeworthia chrysantha* occurs in the southern half of China and as an adventive in

Japan. It is considered by Nakai (1929) as two species which are separated by stoutness of twigs and size of leaf scars. We, however, agree with Hamaya (1955) that there is a gradual transition in sizes and there is no basis for division into two species.

We acknowledge with appreciation the loan of specimens from several herbaria, and information provided by Drs. Lorin I. Nevling, Richard A. Howard, and Frederick G. Meyer.

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TAXONOMIC FERN NOTES, VI — NEW SPECIES OF AMERICAN CYATHEACEAE.

ROLLA TRYON

The many ample collections of tree ferns made during explorations in South America by Julian Steyermark, Bassett Maguire, John Wurdack, Ramón Ferreyra, Benkt Sparre, and Paul Hutchison and Kenneth Wright are an essential source of information for studies of the American Cyatheaceae now in progress. Several of the new species among them are described here in addition to the species of tree fern that is characteristic of the mossy forest of Puerto Rico.

Some of the endemism in the Cyatheaceae in Guayana is reflected in the four new species from that region. Although endemism in the ferns in this area is not as strong as in many groups of flowering plants, it is significant especially with respect to the remarkable morphological innovations.

The species are described under the genera recognized in my recent paper on the classification of the family (Tryon, 1970) and special terms employed are defined there. The illustrations have been prepared by Sally Landry, Mary Robbins, and Lydia Wunsch.

Sphaeropteris sipapoensis Tryon, spec. nov. Figs. 1-4.

Petiolus sine spinis squamis multis persistentibus structura conformi circa 1-2 cm longis brunneolo-albis manifeste ciliatis; lamina bipinnata pinna apicali subconformi; rhachis

squamata; pinnae ad 40 cm longae petiolulatae; pinnulae integra vel aliquantum lobatae subcoriaceae articulatae breviter petiolulatae base late cordata apice subacuto vel acuminato pagina superiore glabra pagina inferiore squamis valde dissectis; venae liberae; sori submarginales plerumque a margine circa 0.5 mm exindusiati paraphysibus longioribus quam sporangiis albidis circa 1 mm longis. Holotypus: Mixed forest at Intermediate Camp, Cerro Sipapo (Paráque), Terr. Amazonas, Venezuela, 2 Feb. 1949, *B. Maguire and L. Politi* 28765, NY. Isotypus: GH.

Sphaeropteris sipapoensis is closely related to *S. marginalis* (Kl.) Tryon of British Guiana and Surinam. The two species share the following characters: large, brownish-white, long-ciliate petiole scales, stalked pinnules, a nearly conform terminal pinna at the lamina apex and the absence of an indusium. *Sphaeropteris marginalis* has the sori farther (mostly 1.2-2.0 mm) back from the margin than *S. sipapoensis* and the paraphyses are shorter (ca. 0.5 mm long) and tan to brown in color. *Sphaeropteris marginalis* also has smaller, less coriaceous, and more deeply lobed pinnules than *S. sipapoensis*. Further collections are required in order to assess the importance of these pinnule characters.

The related *S. marginalis* has been reported from Mexico (for example, by Maxon and Morton, p. 70, 1948) but this is based on an erroneous association of a specimen of the species at Kew ! with the label of *Jurgensen* 915, Sierra San Nolasco, Mexico. Fournier (p. 135, 1872) cites *Jurgensen* 915 as *Hemistegia decurrens* [= *Cnemidaria decurrens* (Liebm.) Tryon], a species of Mexico and undoubtedly the one properly associated with the label.

Sphaeropteris Atahuallpa Tryon, spec. nov. Figs. 5-8.

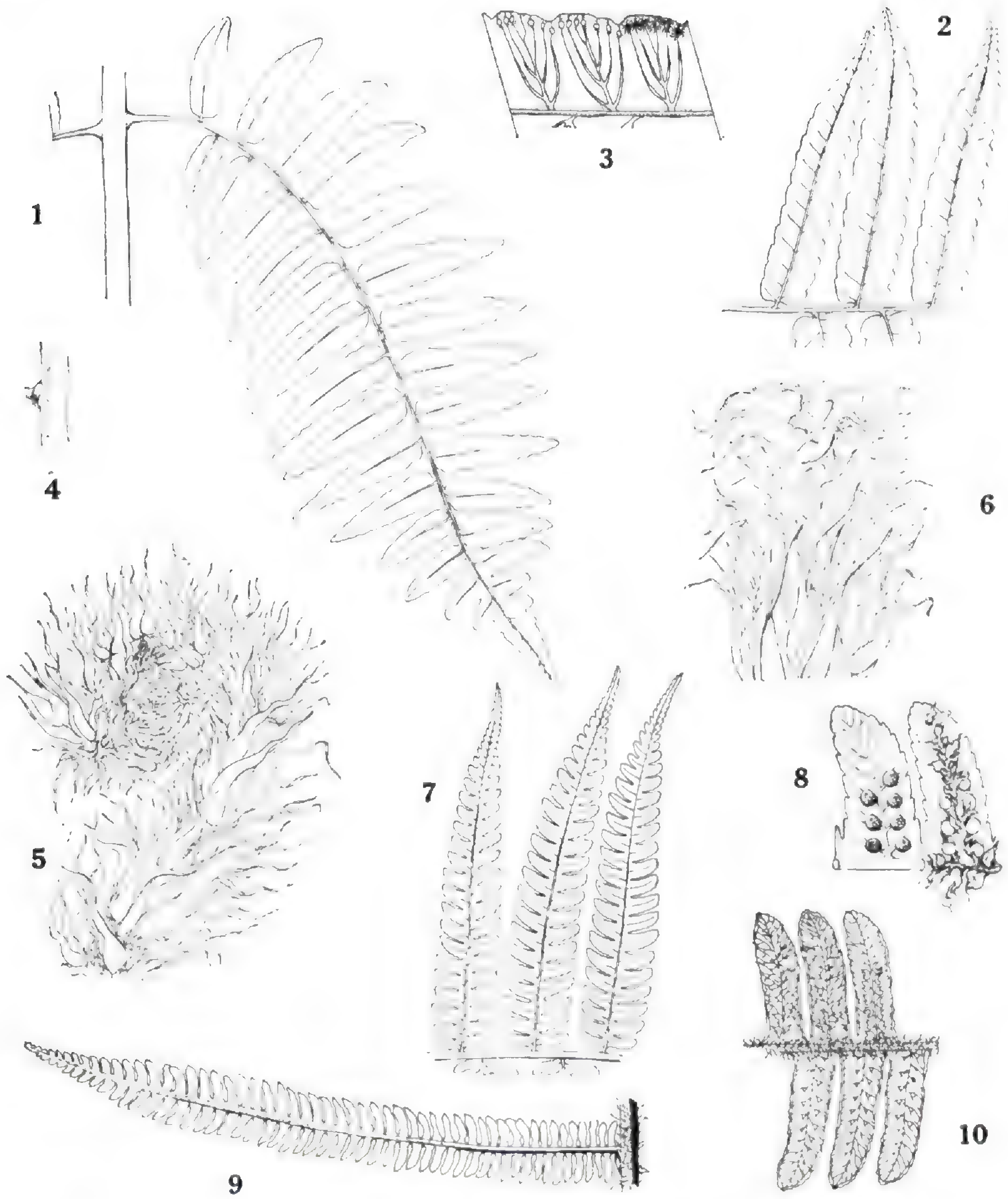
Petiolus parce tuberculatus squamis structura conformi ad 6 cm longis 1 cm latis brunneolo-albis basem versus densissimis persistentibus squamis minoribus longe ciliatis apice filiformi concolori squamellis multis valde dissectis etiam instructus; lamina bipinnato-pinnatifida vel juxta

rhachim bipinnato-pinnatisecta apice sensim acuminato; pinnae ad 70 cm longae subsessiles; pinnulae subsessiles segmentis minime crenato-serratis costulis inferne squamis albidis; venae liberae; sori ad furcam venarum; indusium subfuscum sphaeropteroideum. Holotypus: Cerros Calla Calla, above Balsas on road to Leimebamba, 3000-3100 m, Prov. Chachapoyas, Dept. Amazonas, Peru, 14 Oct. 1964, *P. C. Hutchison and J. W. Wright* 6922, GH. Paratypus: Summit of Puma-urcu, southeast of Chachapoyas, 3100-3200 m, Prov. Chachapoyas, Dept. of Amazonas, Peru, 3 July 1962, *J. J. Wurdack* 1153, GH.

Sphaeropteris Atahuallpa is a distinctive species, related by its sphaeropteroid (globose) indusium only to the species of the *Sphaeropteris horrida* group (Tryon, 1971). From these, however, it differs in the petiole scales which lack a dark apical seta and dark rigid marginal teeth. The largest petiole scales are five to six cells thick near their base. Atahuallpa, a son of Huayna Capac, was Lord-Inca of the Kingdom of Quito. He was captured at Cajamarca by Francisco Pizarro, then ransomed with silver and gold to the present value of perhaps fifty million dollars, and finally betrayed and murdered by Pizarro.

Alsophila bryophila Tryon, spec. nov. Figs. 9-10.

Petiolus brevissimus modice tuberculatus squamis structura marginata brunneis apice seta minima brunnea fragili; lamina pinnato-pinnatisecta vel juxta rhachim bipinnata basem versus modice vel sensim deminuta apice sensim acuminato; rhachis pubescens plus minusve squamata; pinnae ad 15-25 cm longae sessiles costa pagina superiore pubescenti pagina inferiore pubescenti saepe squamis subplanis sine setis fuscatis; segmenta integra coriacea utrinque longe pubescentia costulis basem versus squamis paucis albidis bullatis sine setis; venae liberae; sori ad furcam venarum; indusium hemitelioideum vel meniscoideum. Holotypus: Near West Peak, Luquillo National Forest, Puerto Rico, 12 Nov. 1966, *G. J. Gastony* 12, GH. Paratypi (all from Puerto Rico): *Howard, et al.* 15645, 15722,



Figs. 1-4. *Sphaeropteris sipapoensis*, (*Maguire and Politi* 28765). Fig. 1, basal pinna, × 1/3, GH. Fig. 2, central pinnules of central pinna, × 1/3, NY. Fig. 3, portion of fertile pinnule (paraphyses removed from receptacles to left), × 1, NY. Fig. 4, articulate pinnule base, enlarged, NY.

Figs. 5-8. *Sphaeropteris Atahuallpa* (*Hutchinson and Wright* 6922, GH). Fig. 5, apical portion of crozier, × 1/3. Fig. 6, portion of petiole, × 1/3. Fig. 7, central pinnules of central pinna, × 1/3. Fig. 8, fertile segments: sori and venation (left), with scaly indument (right), × 1 1/3.

Figs. 9-10. *Alsophila bryophila* (*Gastony* 12, GH). Fig. 9, central pinna, × 1/3. Fig. 10, fertile segments: indusia (upper right), with pubescence (upper to left), venation and receptacles (lower), × 1 1/3.

15725, A; *Howard and Nevling* 15740, A; *Shafer* 3305, GH, MO; Shafer 3632, F, NY; *Sintenis* 1480, GH.

Alsophila bryophila grows in wet forests in Puerto Rico at elevations of about 900-1000 m. The species is characteristic of the mossy (elfin) forest of the Luquillo Mountains and the specific epithet is derived from this association.

Alsophila bryophila is close to *A. minor* (D. C. Eaton) Tryon, *A. hotteana* (C. Chr. and Ekman) Tryon and *A. Brooksii* (Maxon) Tryon, from which it can be distinguished by the hemitelioid to meniscoid indusium and the absence of dark setae on the scales of the under surface of the pinnae. The three related species all have a cup-shaped indusium and some, frequently many, scales or squamules on the under surface of the pinnae with dark setae on the margins and a dark seta at the apex. They also have the upper surface of the segments glabrous to rarely sparingly pubescent, which in *A. bryophila* the segments are usually strongly pubescent above. *Alsophila Brooksii,* also in Puerto Rico, is fully bipinnate through most of the lamina. Some materials of *A. hotteana* have a meniscoid indusium but in these specimens it is not certain that the structure is complete. They do have the distinguishing dark-armed indument on the axes beneath.

The other species of American *Alsophila: A. Abbottii* (Maxon) Tryon, *A. capensis* (L. f.) J. Sm., *A. confinis* (C. Chr.) Tryon, *A. dryopteroides* (Maxon) Tryon, *A. Engelii* Tryon, *A. Nockii* (Jenm.) Tryon, *A. paucifolia* Baker, *A. Salvinii* Hook. and *A. Urbanii* (Brause) Tryon, differ from *A. bryophila* in having a cup-shaped indusium and (or) in having a fully bipinnate or more complex lamina, and in different indument on the under surface of the pinnae.

Alsophila bryophila has long been known under the name of *Cyathea pubescens* Kuhn. That species, however, is *Nephelea pubescens* (Kuhn) Tryon and is endemic to the Blue Mountains of Jamaica (Gastony, 1972). *Cyathea*

pubescens has also been ascribed to Cuba and Hispaniola (Maxon, p. 386, 1926), but the specimens from those islands belong to *Alsophila minor.*

Trichipteris Steyermarkii Tryon, spec. nov. Figs. 11-12.

Petiolus basem versus acute tuberculatus squamis structura marginata; lamina bipinnata pinna apicali conformi; pinnae circa 25-35 cm longae articulatae breviter petiolulatae; pinnulae integrae vel subintegrae coriaceae articulatae breviter petiolulatae base cordata apice subacuto vel acuto pagina superiore glabra pagina inferiore squamis paucis brunneolis subplanis; venae liberae; sori ad furcam venarum exindusiati paraphysibus brevioribus quam sporangiis. Holotypus: Bosque nublado virgen en la cumbre, Cerro de Humo, Peninsula de Paria, Estado Sucre, Venezuela, 2 Mar. 1966, *J. A. Steyermark* 94923, VEN. Isotypi: GH, U. Paratypus: Selva nublada en la cumbre plana, Cerro Patao, Peninsula de Paria, Estado Sucre, Venezuela, 19 Jul. 1962, *J. A. Steyermark and G. Agostini* 91048, VEN.

Trichipteris Steyermarkii is related in its lamina architecture and articulate pinnae and pinnules to *T. sagittifolia* of Trinidad and to *T. cordata* of the states of Aragua and Carabobo, Venezuela. Both species differ from *T. Steyermarkii* in having bullate scales on the lower surface of the pinnules (*T. sagittifolia* also has some flattish ones). Futher differences are the many long slender spines at the base of the petiole of *T. sagittifolia* and the pinnately lobed pinnules of *T. cordata.*

Hooker (p. 37, 1865) questioned the source of the Cruger collection upon which *Alsophila sagittifolia* was based: "Trinidad ? (possibly the opposite coast of Venezuela)". The type collection (Kew !) has bullate scales on the pinnules and corresponds with the Trinidad species (for example, *Fendler* 142 and 143).

Trichipteris Cyclodium Tryon, spec. nov. Figs. 13-14.

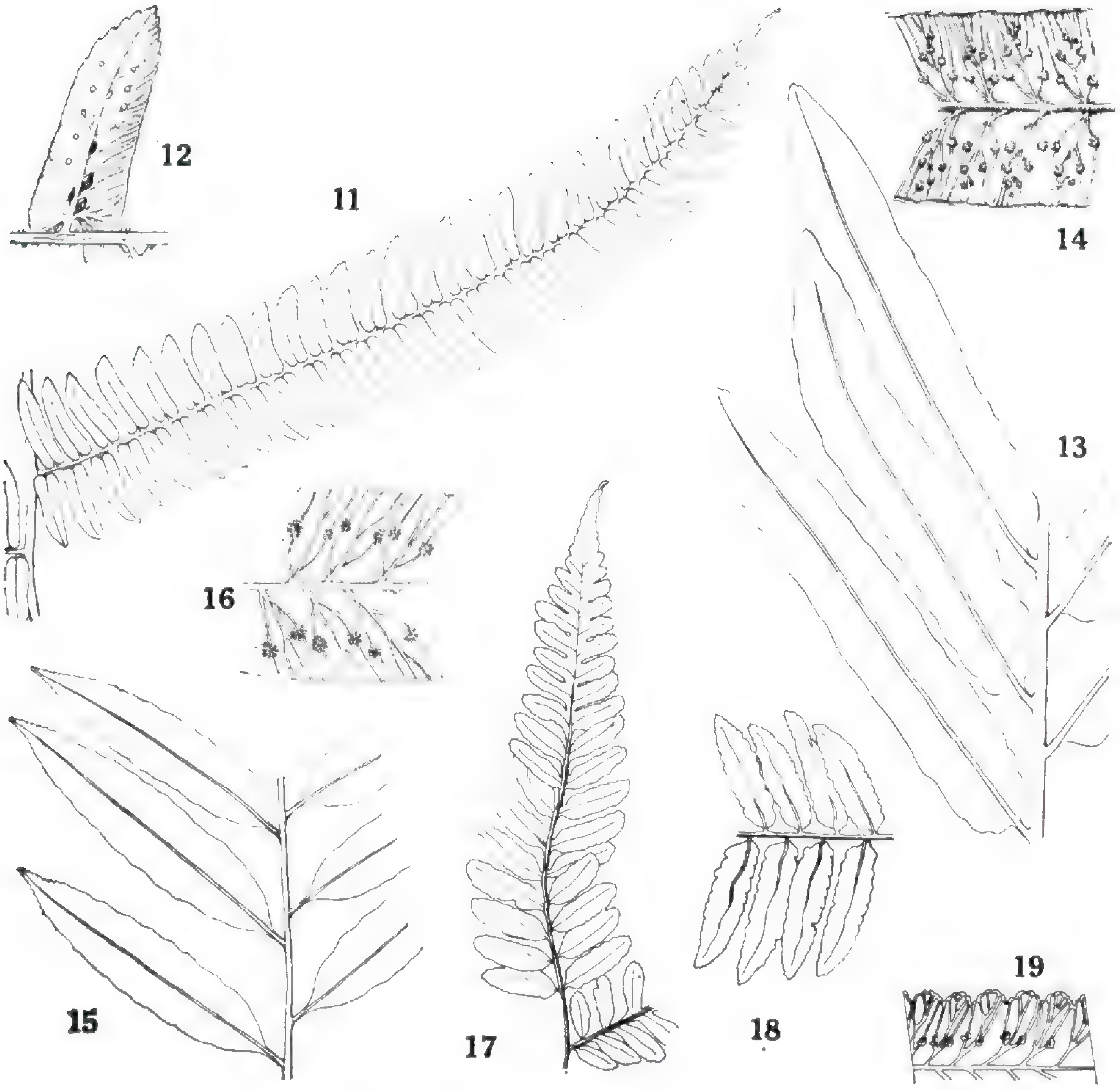
Petiolus sine spinis squamis structura marginata brunneis albido-limbatis dense ciliatis; lamina 1-pinnata pinna

apicali conformi articulata; pinnae circa 15-18 cm longae valde ascendentes integrae late crenatae vel minime pinnatilobatae valde coriaceae articulatae petiolulatae utrinque glabrae vel subglabrae base late cuneata apice obtuso; venae liberae utrinque elevatae; sori plerumque in venis simplicibus 3-4 seriati exindusiati paraphysibus longioribus quam sporangiis. Holotypus: Camp Savanna, Cerro Sipapo (Paráque), Terr. Amazonas, Venezuela, 6 Dec. 1948, *B. Maguire and L. Politi* 27541, NY. Isotypus: GH.

Trichipteris Cyclodium is a very distinctive species. The lamina has a close resemblance to that of *Cyclodium meniscioides* (Willd.) Presl (a species that can also be placed in *Stigmatopteris* or *Dryopteris,* depending upon how generic lines are drawn). *Trichipteris Cyclodium* is related to *T. Williamsii* (Maxon) Tryon of Panama and to the next species *T. Maguirei* by its simple, articulate and stalked pinnae and by its lamina with a conform terminal pinna. It differs from *T. Williamsii* in its very coriaceous, strongly ascending, obtuse pinnae and whitish-bordered petiole scales. *Trichipteris Williamsii* has the pinnae only moderately thickened, patent and long-acuminate and the petiole scales are entirely whitish or have a brown stripe toward the apex. A comparison with *T. Maguirei* is made under that species.

Trichipteris Maguirei Tryon, spec. nov. Figs. 15-16.

Petiolus sine spinis squamis structura marginata brunneis albido-limbatis dense ciliatis; lamina 1-pinnata pinna apicali conformi articulata vel apice binato; pinnae circa 8-12 cm longae integrae coriaceae articulatae utrinque glabrae pinnis basilaribus circa 7 mm petiolulatis base cuneata apice abrupte acuminato serrato; venae liberae vel aliquot junctae utrinque elevatae; sori plerumque in venis simplicibus 1-2 seriati exindusiati paraphysibus longioribus quam sporangiis. Holotypus: Frequent, terrestrial, talus forest near first escarpment, Cerro Sipapo (Paráque), Terr. Amazonas, Venezuela, 11 Dec. 1948, *B. Maguire and L. Politi* 27597, NY. Isotypus: GH. Paratypi: (all from



Figs. 11-12. *Trichipteris Steyermarkii* (*Steyermark* 94923, VEN). Fig. 11, central pinna, × 1/3. Fig. 12, fertile pinnule, with receptacles and scales, × 1.

Figs. 13-14. *Trichipteris Cyclodium* (*Maguire and Politi* 27541, NY). Fig. 13, central pinnae, × 1/3. Fig. 14, portion of fertile pinna, with sori, × 2/3.

Figs. 15-16. *Trichipteris Maguirei* (*Maguire and Politi* 27597, GH). Fig. 15, central pinnae, × 1/3. Fig. 16, portion of fertile pinna, with sori, × 1.

Figs. 17-19. *Cyathea Steyermarkii* (*Steyermark* 105194, GH), Fig. 17, lamina apex, × 1/3. Fig. 18, central pinnules of central pinna, × 1/3. Fig. 19, portion of fertile pinnule, with receptacles, × 1.

Terr. Amazonas, Venezuela) Terrestrial, uncommon, wet montane moss forest, Phelps Camp to North Savanna, 1400 m, Cerro Sipapo (Paráque), 17 Dec. 1948, *B. Maguire and L. Politi* 27752, NY; terrestrial, wet mixed montane forest, slope above Cano Grande, 1500 m, Cerro Sipapo (Paráque), 21 Jan. 1949, *B. Maguire and L. Politi* 28493, NY; dense woodland along right fork of Cano de Dios, 1900 m, Cerro Huachamacari, Río Cunucunuma, 13 Dec. 1950, *B. Maguire, R. S. Cowan and J. J. Wurdack* 30188, NY.

Trichipteris Maguirei differs from the preceding species, *T. Cyclodium,* in its smaller pinnae that are cuneate at the base and abruptly acute to acuminate at the apex, and in the lamina that often has a pair of terminal pinnae. The larger pinnae of *T. Cyclodium* are broadly cuneate at the base and obtuse at the apex, and the lamina has a single terminal pinna. *Trichipteris Maguirei* is perhaps more closely related to *T. Williamsii,* but differs from it in the smaller pinnae, ca. 8-12 cm. long, the shorter pinna stalks, those of the basal pinnae being ca. 7 mm long, and the petiole scales with whitish borders. In *T. Williamsii,* the pinnae are ca. 15-20 cm long, the stalks of the basal ones are ca. 13 mm long, and the petiole scales are entirely whitish or have a brown stripe toward the apex.

Cyathea Steyermarkii Tryon. spec. nov. Figs. 17-19.

Petiolus basem versus modice muricatus squamis structura marginata brunneis brunneolo-albis-limbatis; lamina bipinnata pinna apicali conformi articulata; pinnae circa 25-30 cm longae articulatae petiolulatae apice sensim acuminato; pinnulae non articulatae crenatae vel aliquantum pinnatilobatae chartaceae base cuneata apice obtuso vel subacuto; venae liberae; sori plerumque in venis simplicibus inter costam et marginem medii; indusium parvum hemitelioideum. Holotypus: Cumbre del Cerro Autana, 4° 52″ N. lat. 67° 27″ W. long., 1230-1270 m, Terr. Amazonas, Venezuela, 21-22 Sept. 1971, *J. A. Steyermark* 105194, GH.

Cyathea Steyermarkii is related to three other species with a hemitelioid indusium: *Hemitelia conformis* Tryon, *H. petiolata* Hook. and *H. Woronovii* Maxon and Morton. I placed the first two in *Cnemidaria* (Tryon, 1970) ; however, Robert Stolze, who is monographing the genus, informs me that these species and *H. Woronovii* are to be excluded and properly belong in *Cyathea*. *Hemitelia petiolata* is the only one of these hemitelioid species that has been placed in *Cyathea* (as *C. panamensis* Domin). The three species have the sori close to the margin, while in *C. Steyermarkii* the sori are about half way between the costa and the margin. *Hemitelia petiolata* and *H. Woronovii* have the apex of the lamina gradually reduced to the tip, while in *C. Steyermarkii* the apex is a conform terminal pinna. *Hemitelia conformis* is further distinguished by the pinnae that have a conform, articulate terminal pinnule. In *C. Steyermarkii* the pinnae are gradually reduced at the apex.

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NEW SPECIES IN THE PHACELIA CRENULATA GROUP (HYDROPHYLLACEAE)[1]

N. Duane Atwood

While preparing a taxonomic revision of the *Phacelia crenulata* group it was necessary to investigate the relationships of several taxa in southern Utah, northern Arizona and Mexico. These investigations demonstrated the presence of several previously undescribed taxa. These areas are well known for their varied geology, topography and climate. They have also been some of the least botanized and most poorly understood localities within the range of the *P. crenulata* group. Therefore, it is not surprising that new species are present, particularly in a genus which contains many taxa with restricted distribution. The purpose of this paper is to present the diagnoses, descriptions, distributions, and illustrations of the proposed new taxa.

The herbaria where specimens are deposited are abbreviated according to Lanjouw and Stafleu (1964). Those herbaria not listed in Lanjouw and Stafleu are as follows: Dixie Junior College, St. George, Utah (DIX), Weber State College, Ogden, Utah (WSC), and West Texas State University, Canyon, Texas (WTS).

The author is grateful to the curators of herbaria that were visited or who sent loan material for this study, and to Mrs. Kaye Thorne for preparation of the illustrations.

Phacelia constancei Atwood sp. nov.

A *P. palmeri* differt caulibus brevioribus, foliis angustioribus et revolutioribus, et caulibus rubellis pilioribus et ramis lateralibus frondosioribus.

Herba biennis erecta, 1.5-4.3 dm alta, frondosa omnino; folia petiolata (pro parte maxima), 1.0-10 cm longa, 0.3-

[1]This study was supported in part by the Department of Botany and Range Science, Brigham Young University, Provo, Utah, and by Cost of Education Funds from a National Defense Education Act Title IV Fellowship.

1.5 cm lata, involuta, e undulata ad pinnatifida, lineares lanceolata, hirsutula supra, pilis glandularis dispersis; caules crasses, simplices vel ramosi omnino, rubelli, e hirsutuli ad hirsuti, et minute glanduliferi; inflorescentia, cymarum scorpiodorum compositorum; pediceli usque ad 1 mm longi; sepala e elliptica ad oblanceolata, 3-4 mm longa, hirsutuli ad hirsuti et stipitata glandulifera; corolla tubularis, 5-6 mm longa; stamina exserta 3-4 mm; stylus furcatus pubescens infimus 1/3, exsertus 3-4 mm stamina longior; capsula subglobosa, hirsutula et glandulifera omnino, sepala brevior; semina 4, nigricantia, 2.5-2.8 mm longa, 1.0-1.2 mm lata, elliptica, margines corrugati, pagina ventralis foveolata, excavata et divisa porca prominens, porca lata una corrugata, pagina dorsalis foveolata.

TYPE: **Arizona:** COCONINO COUNTY: 1 mi north of Fredonia, on clay hills, growing with *Sarcobatus, Lycium, Astragalus,* and *Phacelia corrugata,* 27 May 1968, *D. Atwood* 1385A (HOLOTYPE: BRY; ISOTYPES: ARIZ, ASC, CAS, DIX, GH, NY, POM, RM, UC, US, UT, UTC, WSC).

Additional materials examined: **Arizona:** MOHAVE COUNTY: ca 19 mi south of Kanab Indian Reservation (southern boundary) on road to Tuweep junction, 27 May 1969, *D. Atwood* 1765, (BRY); 5 mi northeast of Tuweep, 17 August 1946, *K. F. Parker, et al.* 6254, (GH, NY, POM, US); ca 4 mi north of Tuweep junction, 27 May 1969, *D. Atwood* 1761, (BRY, CAS); 1 mi north of Fredonia, 5 June 1968, *D. Atwood* 1529, (BRY, GH, UC); 1 mi north of Fredonia, 27 May 1969, *D. Atwood* 1785, (ARIZ, BRY, CAS, NY, US, UTC, WSC); **Utah:** KANE COUNTY: ca 30 mi east of Kanab along Hwy 89, mi post 30, 6 June 1968, *D. Atwood* 1532, (BRY, CAS, GH, NY, US); 15 mi east of Kanab, 5 June 1969, *D. Atwood* 1739A, (ARIZ, BRY, US, UT); 15 mi east of Kanab, 5 June 1942, *Ripley & Barneby* 4836, (CAS, RSA); 20 mi east of Kanab, 5 June 1969, *D. Atwood* 1792B, (BRY, CAS, GH, NY, POM, RM, US); ca 32 mi east of Kanab along Hwy 89, 6 June 1968, *D. Atwood* 1532A, (BRY, POM, RSA); ca 3.7 mi east of Skutumpah-Alton junction at head of Johnston Canyon (R.4. 5W., T.40S.), 7 June 1969, *D. Atwood* 1801A, (BRY).

Taxonomically, *Phacelia constancei* (Figure 1, Map 1) appears to be most closely related to *P. palmeri* Torr. ex S. Wats., but is distinguished from that species by the smaller growth form, narrower and more revolute leaves, the stems are reddish with shorter and fewer hairs and the lateral inflorescence branches are more leafy.

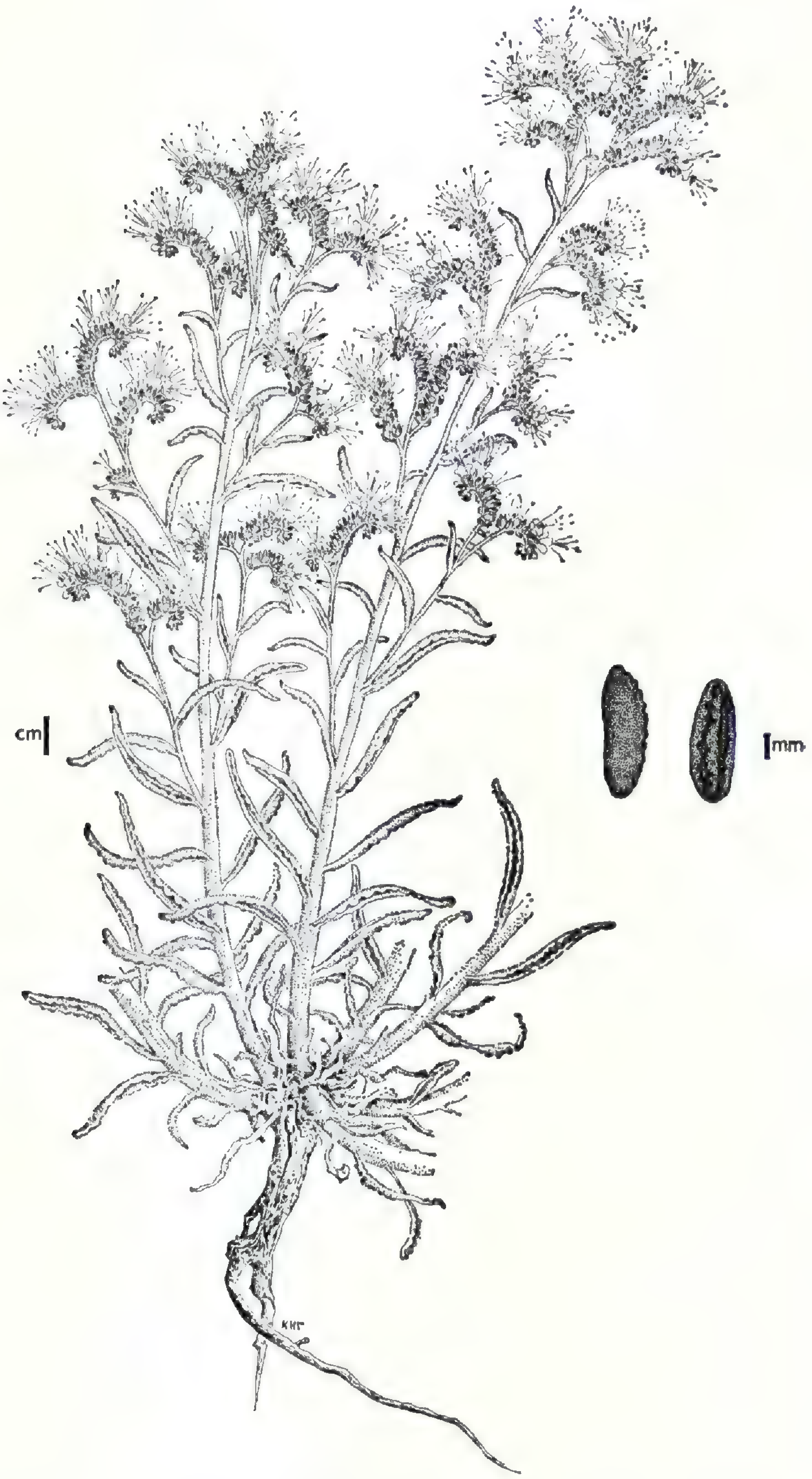
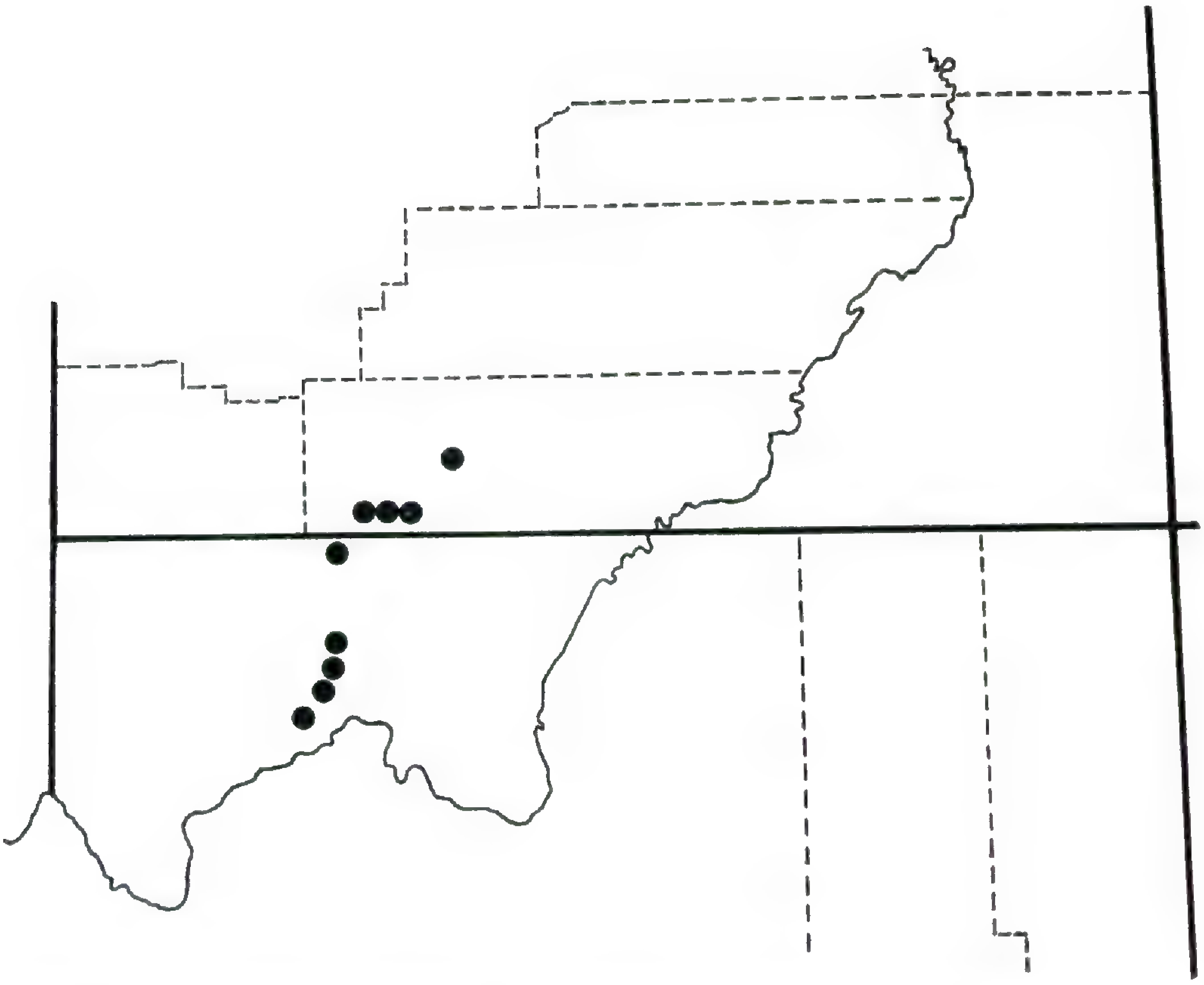


Fig. 1. *Phacelia constancei.* Habit and seed of plant.



Map 1. Southern Utah and northern Arizona. Range of *P. constancei.*

The latter occurs from Mohave County, Arizona, west to Washington and Iron County, Utah, and in Clark County, Nevada. The new taxon is known only from restricted areas in Mohave County, Arizona north to Kane County, Utah. Both species grow on alkaline clay bluffs and flats of the Moenkopi Formation, late May to mid August. Chromosome voucher specimen (n=11): Tuweep Valley, 5 mi ne. of Tuweep, 17 August 1946, *K. F. Parker et al.* 6254, (UC).

This species is named in honor of Dr. L. C. Constance, University of California at Berkeley, who has made numerous important contributions in the genus *Phacelia.*

Phacelia rafaelensis Atwood sp. nov.

A *P. utahensis* differt corolla tubularo diluta et canaliculata lobis aliquatum expansis, staminibus et stylis exsertis tantum 3-5 mm, filis et antheris tristis, semine porca interdum corrugata.

Herba biennis, erecta, 0.8-5.4 dm alta; caules crassi simplices vel interdum ramosi basi, e olivacei ad brunnei glandiferi et hirsuti; folia basalia petiolata dentata ad pinnatifida, 2-7 cm longa, 0.5-1.5 cm lata, strigosa ad hirsuta, folia caulina sessilia, undulati-crenata ad dentata, oblonga ad lanceolata, 1.0-10 cm longa, 0.5-3.5 cm lata, strigulosa ad hirsuta et sparsim stipitati-glandulifera; inflorescentia terminalis proparte maxima interdum axillaris, paniculata; flores fere sessiles; sepala oblonga ad spathulata, 3-4 mm longa in fructis, 1.0-1.7 mm lata, glandulifera et hirsuta; corolla tubularis pallida, 5-6 mm longa; stamen et stylus exsertus 3-5 mm; stylus ¾ longitudis, pubescens infernus ½; capsula globosa, 4-5 mm longa, stipitati-glandulifera et hirsuta; semina 4, elliptica ad oblonga, 3.4-4.0 mm longa, 1.5-2.0 mm lata, pagina ventralis alveolata pallidior pagina dorsalis, excavata et divisa porca prominenti, porca lata una corrugata, margines integrae, pagina dorsalis brunnea et alveolata radose.

TYPE: **Utah:** WAYNE COUNTY: Capital Reef National Monument, red clay hills (Moenkopi Formation) southeast of visitor center, 12 June 1969, *D. Atwood & L. C. Higgins* 1834, (HOLOTYPE: BRY; ISOTYPES, ARIZ, ASC, B, BRY, CAS, COLO, DIX, GH, JEPS, MEXU, NY, POM, RM, RSA, UC, US, UT, UTC).

Additional materials examined: **Arizona:** COCONINO COUNTY: Lee's Ferry, 16 June 1890, *M. E. Jones* s.n., (POM); 2 mi w. of Navajo Bridge, 12 May 1955, *Ripley & Barneby* 12664, (CAS); MOHAVE COUNTY: 2 mi e. of Fredonia, 6 June 1942, *Ripley & Barneby* 4362, (RSA); ca 4 mi w. of Fredonia, mi post 22, 27 May 1968, *D. Atwood* 1390, (ARIZ, ASC, BRY, CAS, POM, US); 1 mi n. of Fredonia, 5 June 1968, *D. Atwood* 1530, (BRY, B, POM); ca 4 mi s. of Fredonia-Pipe Springs road, 13 May 1952, *E. McKlintock* 52-600, (CAS); **Utah:** EMERY COUNTY: Chinle Formation, at jct of Buckhorn Wash & San Rafael River Canyon north of river, 30 May 1970, *Welsh, Atwood & Moore* 9819, (ARIZ, ASC, B, BRY, CAS, GH, NY, RM, RSA, UC, US, UT, UTC, WSC); 2 mi s. of San Rafael River Bridge, 16 June 1969, *D. Atwood* 1843, (ARIZ, ASC, B, BRY, GH, NY, US, WSC); 11 mi n. of Goblin Valley turn off on Temple Mountain road from US 24, thence 43 mi s.w. on mining road, 17 June 1969, *D. Atwood* 1855, (BRY, RM); R.9E., T.26S., San Rafael Swell, 17 June 1969, *D. Atwood* 1847, (ARIZ,

ASC, B, BRY, CAS, GH, NY, UC, US, UT, UTC); ca 13 mi e. of Buckhorn Wash, north of San Rafael River, 30 May 1970, *Welsh, Atwood & Moore* 9846, (BRY); ca 5 mi e. of Buckhorn Wash along road north of San Rafael River, 30 May 1970, *Welsh, Atwood & Moore* 9844, (ARIZ, B, BRY, CAS, GH, NY, US); ca 2 mi w. of San Rafael River Bridge at jct. of Buckhorn Wash and San Rafael River, 1 June 1970, *Welsh, Atwood & Moore* 9903, (BRY, NY, US, WSC); WASHINGTON COUNTY: 11 mi w. of Hurricane, 2 May 1942, *F. Gould* 1681, (CAS, UC); near Virgin, 10 May 1941, *Eastwood & Howell* 9200, (CAS); e. of Bloomington, 10 April 1970, *Welsh, Atwood & Matthews* 9535, (BRY, NY, UC, WSC); 2 mi e. of Hurricane, 27 May 1968, *D. Atwood* 1409, (BRY, CAS); Rockville, 12 May 1941, *Eastwood & Howell* 9327, (CAS, GH); 4 mi s.w. of Saint George, 27 May 1968, *D. Atwood* 1417, (BRY); Moenkopi Formation at Bloomington, 3 May 1970, *Welsh, Atwood & Matthews* 9694, (BRY); clay hills n. of Bloomington, 25 May 1969, *D. Atwood* 1698, (ARIZ, ASC, B, BRY, CAS, GH, JEPS, NY, RM, UC, UTC, WSC); ca 5 mi s.w. of St. George, 7 April 1968, *Higgins* 1244, (BRY); WAYNE COUNTY: Capital Reef Wash 2 mi s.e. of Fruita, 6 May 1940, *B. Maguire* 18146, (CAS, NY, UC, UTC); 3 mi s. of Highway 24 on Notom Road, 17 June 1969, *D. Atwood* 1860, (ASC, BRY, CAS, GH, RSA, UC, UT, US, WSC); Moenkopi Formation at Fruita, 10 May 1969, *Welsh Atwood & Higgins* 8968, (BRY, CAS, RM, RSA, UC, US, UT); 3 mi w. of Fruita, 4 June 1953, *R. McVaugh,* 14438, (CAS, NY, UC).

Phacelia rafaelensis appears to be related to *P. utahensis* but differs from that species as indicated in the diagnosis. *P. utahensis* is endemic to the Arapien Shale Formation in Sevier and San Pete County, Utah, whereas *P. rafaelensis* (Figure 2, Map 2) occurs from Emery County south to Kane County, Utah and Mohave County, Arizona and east to Washington County, Utah. It grows on clay hills of the Moenkopi Formation. mid April to mid June.

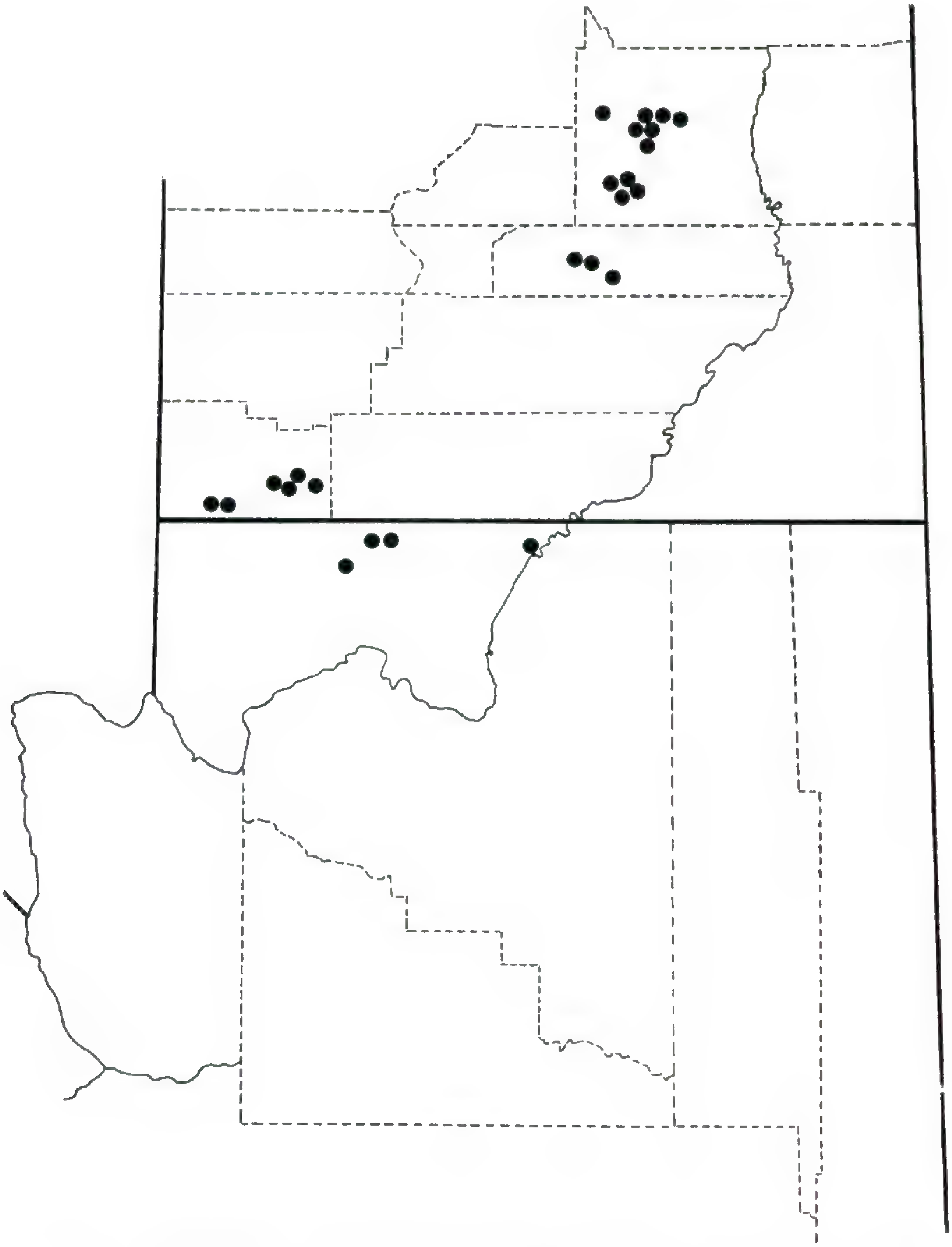
This species is named for the San Rafael Swell, a floristically unique area, in Emery County, Utah.

Phacelia howelliana Atwood sp. nov.

A. *P. corrugata* differt corollis pusillioribus et tubo albo, seminibus diluti-marginatis dorsalibus laevibus, plantis brevioribus et plerumque ramosis et frondosis basi.

Plantae annuae, 0.9-2.3 dm altae; caules pro parte maxima et frondosi ad basin versus, glandulifera et aliquot pili longiores simplices praesenta; folia e late oblonga ad ovales,

Fig. 2. *Phacelia rafaelensis.* Habit and seed of plant.



Map 2. Southern Utah and northern Arizona. Range of *P. rafaelensis*.

2-6 cm longa, 1.0-2.5 cm lata, irregulariter crenata ad lobata, strigosa et leviter glandulifera, petiolus usque ad 5.0 cm longa; inflorescentia cymarum scorpiodorum compositorum, pedicelli usque ad 2.0 mm longi; sepala linearia ad anguste oblanceolata, 3.5-4.0 mm longa, 1.0-1.5 mm lata, glandulifera et hirsuta; corolla 5-6 mm longa, 6-7 mm lata, rotata ad infundibuliformis, lobi pallidi violacei, tubus albus, stamina et stylus exsertus 3-4 mm, stylus breviores stamina furcatus ¾ longitudo pubescens infirmus ¼; capsula oblonga ad subglobosa glandularis et hirsutulosa apprime versus apex; semina 4, brunnea, 3.2-4.0 mm longa, 1.4-1.8 mm lata, elliptica, margines corrugati usque involuti ad complanati, pagina ventrali foveolata, excavata et divisa porca prominens, interdum curva lata una et vix corrugata, pagina dorsalis prophyreus laevis et margo pallida circumtineta.

TYPE: **Utah:** SAN JUAN COUNTY: ca 0.4 mi n. of Bluff, Utah on highway 163, in mouth of canyon on rocky-sandy-clay soil, 13 May 1970, *D. Atwood* 2454, (HOLOTYPE: BRY; ISOTYPES, ARIZ, ASC, B, BRY, CAS, GH, NY, RM, UC, US, UTC).

Additional materials examined: **Utah:** GRAND COUNTY: 13 mi n. of Moab, 15 June 1944, *A. H. Holmgren & S. Hansen* 3319, (NY); Moenkopi Formation, T.25S., R.23E., in Castle Valley, 5 June 1970, *Welsh, Atwood & Moore* 9957, (ARIZ, BRY, CAS, WTS); Arches National Monument, vicinity of Courthouse Wash, 2 May 1963, *G. L. Pyrah, et al.* 71, (BRY); Potash Plant, 20 April 1962, *S. L. Welsh*, 1670A, (BRY); SAN JUAN COUNTY: Bluff, near the Navajo Twins, 29 April 1961, *D. Bright* 55, (BRY); Bluff, 24 May 1919, *M. E. Jones* s.n., (POM); along road just w. of Monument Valley Hospital, 15 May 1970, *D. Atwood* 2511, (ARIZ, ASC, B, BRY, CAS, DIX, GH, JEPS, NY, POM, RM, RSA, UC, US, UTC, WSC); Goulding Trading Post); 26 June 1948, *J. T. Howell* 24687, (CAS); canyon of the San Juan River between Bluff and the Colorado River, *P. Thompson* s.n., May 1941, (CAS); dark canyon-Cataract Canyon, 1 July 1938, *E. Clover & M. Jotter* 2143A, (GH); ca 2 mi e. of Bluff, 12 May 1944, *A. H. Holmgren* 3187, (UTC).

This entity is related to *P. corrugata* A. Nels. which ranges throughout most of Utah and extends into Colorado, northern New Mexico and northern Arizona. It is distinguished from *P. corrugata* by its low much branched growth

form, smaller corolla and white tube. The leaves are mostly basal and the seeds are different as indicated in the diagnosis and general description. *P. howelliana* (Figure 3, Map 3) is known only from San Juan and Grand Counties, Utah where it grows in red sandy, gravelly or sandy-clay soils at ca 4500 to 5000 feet. It probably occurs in Colorado near Moab and undoubtedly in Monument Valley in

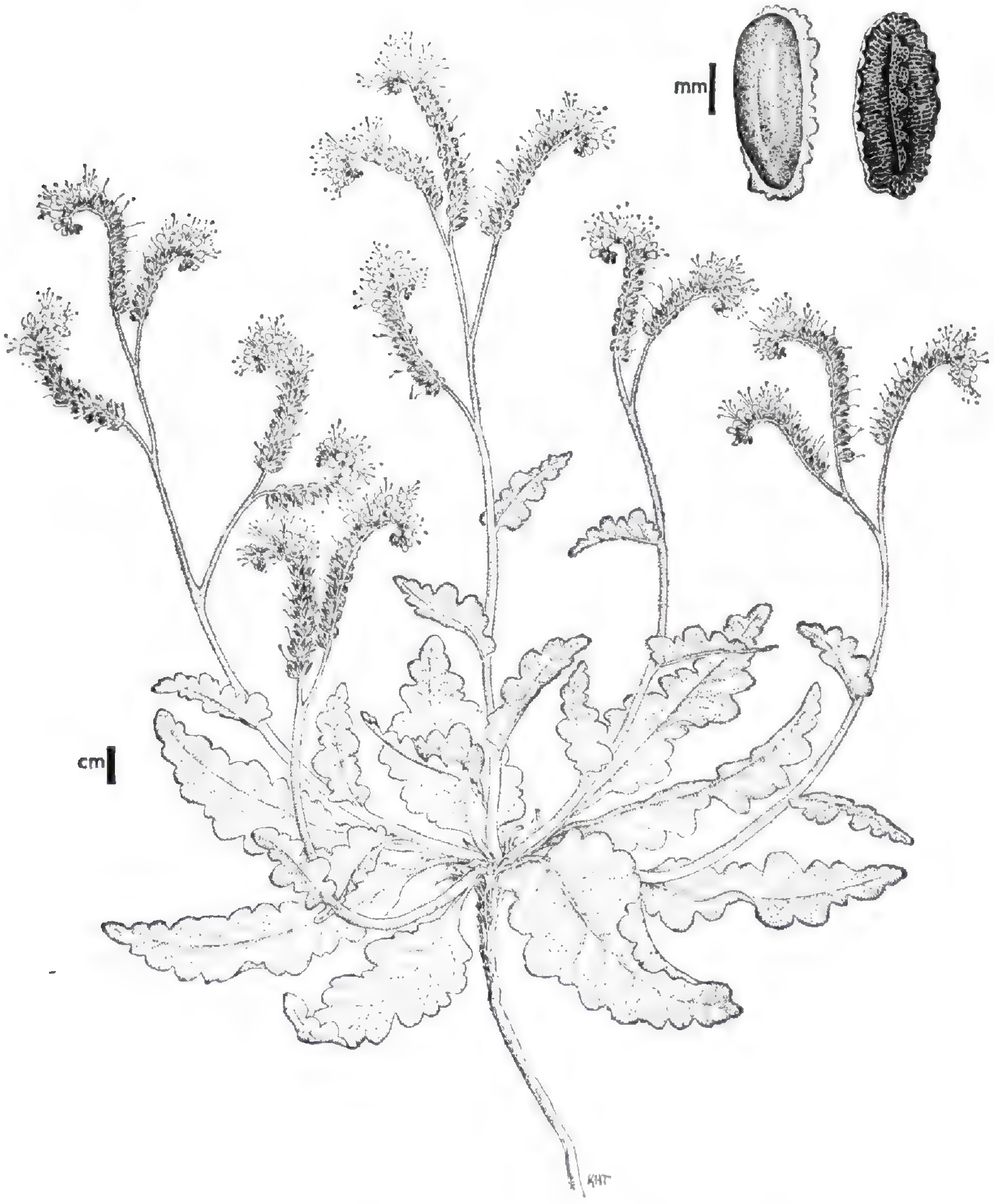
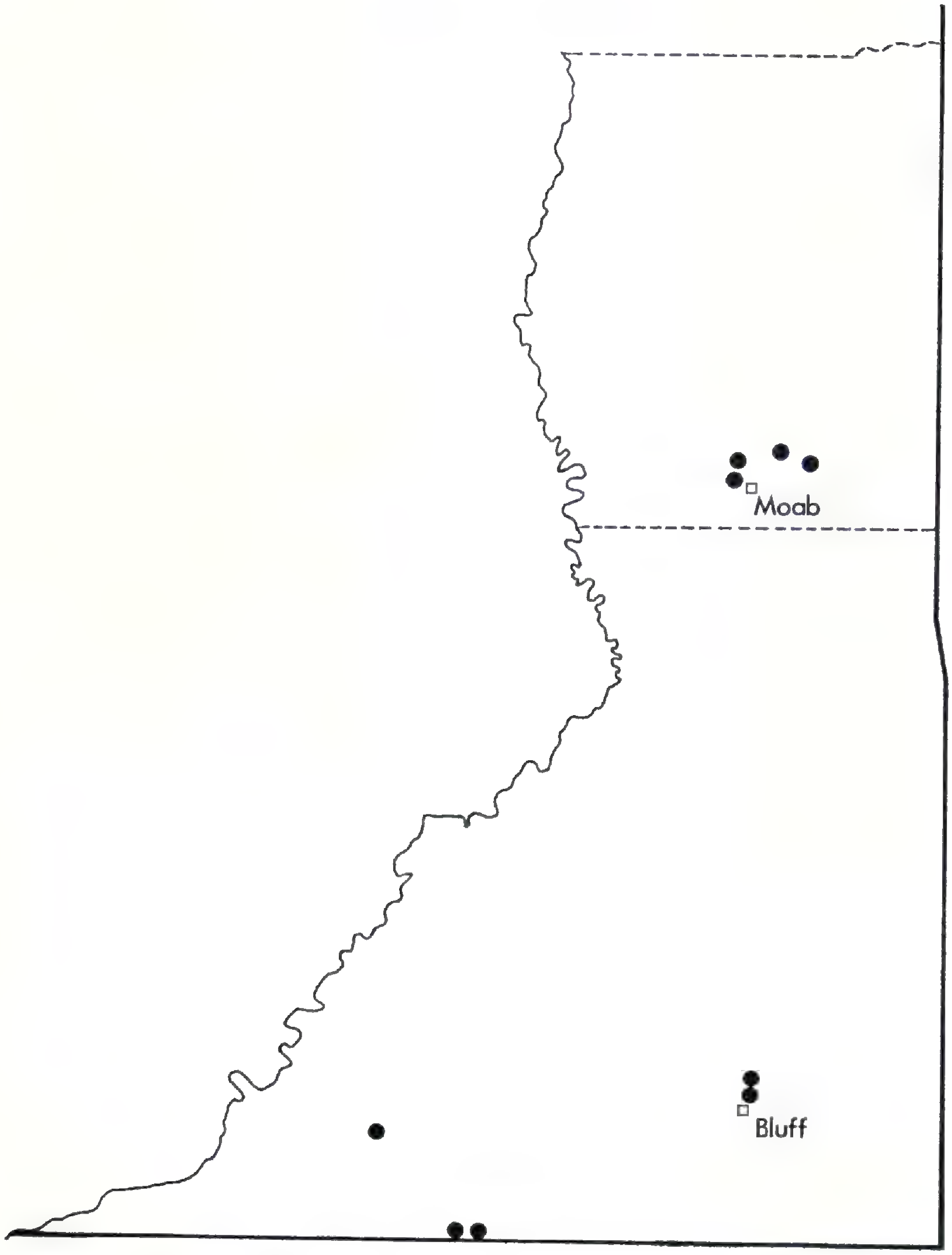


Fig. 3. *Phacelia howelliana.* Habit and seed of plant.



Map 3. Southern Utah, Grand and San Juan Counties. Range of *P. howelliana.*

Arizona, although no specimens have been seen from either area.

This species is named in honor of John Thomas Howell at the California Academy of Sciences, who has published many important works within the genus *Phacelia*.

Phacelia vossii Atwood sp. nov.

Plantae perennis, 2.1-7.3 dm altae; caules erecta e caudice ligneo, hirsutis ad hirsutulis et stipitati-glanduliferis pilis; folia lineara ad lanceolata, 2.0-11 cm lata, revoluta, pagina ventralis glandulifera dense, pagina dorsalis hirsuta et stipitate-glanduliferis dispersis, margines dentatae ad irregulariter dentatae, petiolata, petiolus usque ad 1.5 cm longa; inflorescentia terminalis vel secus caules dispersa usque ad ½ longitudo vel, minus, simplex ad cymarum scorpiodorum compositorum, racemi individua usque ad 7.5 cm longa per fructus, pedicelli usque ad 2.0 mm longa per fructus, glandulifera et hirsuta; corolla tubularis (campanulata ?), diluta purpurascens ad albida (?), 5.5 mm longa; sepala oblanceolata ad spathulata, 4-6 mm longa, 1.5-2.0 mm lata, glandulifera et hirsuta; stamina exserta; stylus exserta circa 2.0 mm stamina longior, circa 9.0 mm longa, furcatus ¾ longitudo, inferna ¼ pubescens; capsula ovata, 3.7 mm longa, 2.5-2.7 mm lata, glandulifera et strigosa; semina 4, elliptica ad oblonga, 2.5-3.1 mm longa, 1.0-1.4 mm lata, margines integra ad corrugata parte, pagina dorsalis foveolata, pagina ventralis foveolata et porca prominentia centrale corrugata, porca excavata utrinque.

TYPE: **Mexico:** NUEVO LEON: Sierra Madre Oriental, calcite and limestone hills beyond Pablillo toward Santa Clara, about 15 mi s.w. of Galeana, sparse in arroyos, flowers light purple, 18 July 1934, *C. H. & M. T. Mueller* 1075, (HOLOTYPE: GH; ISOTYPE, MEXU).

Additional materials examined: **Mexico:** NUEVO LEON: Hacienda Pablillo, Galeana, 13 August 1936, *Mary Taylor* 156, (UC, NY).

Phacelia vossii (Figure 4, Map 4) is known only from the type collections by Galeana in the State of Nuevo Leon, Mexico. It apparently grows in calcite and limestone soils.

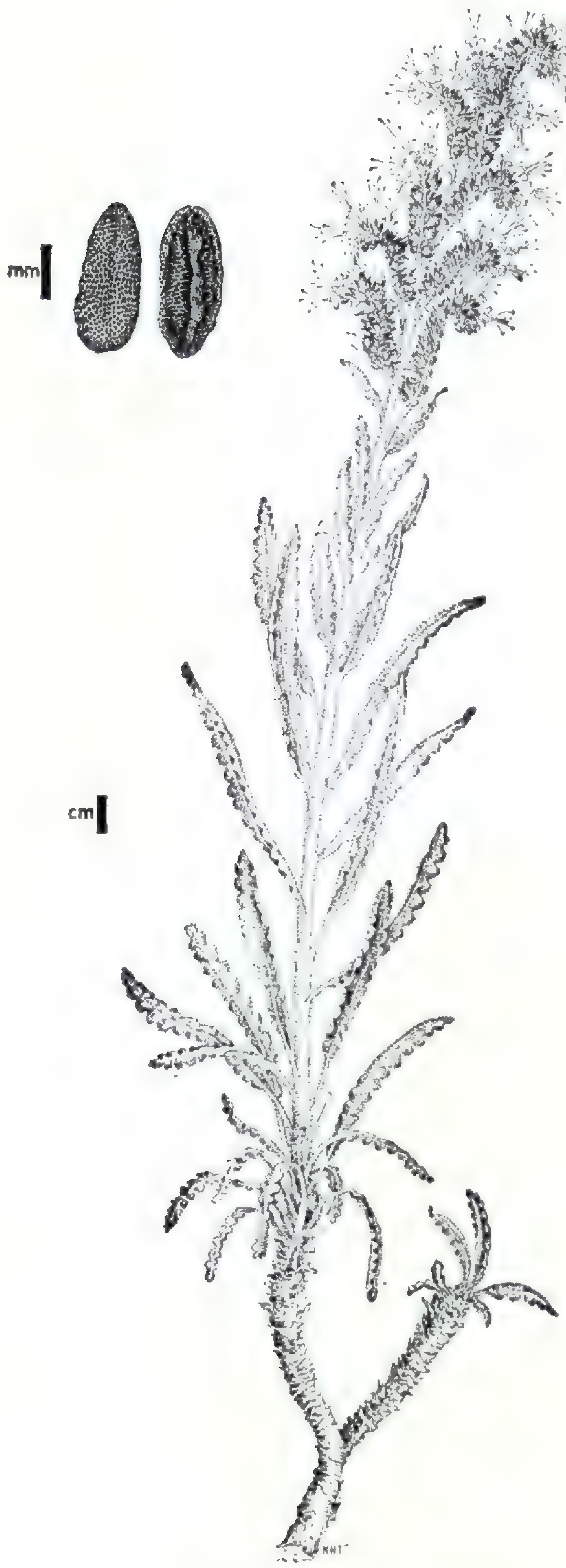
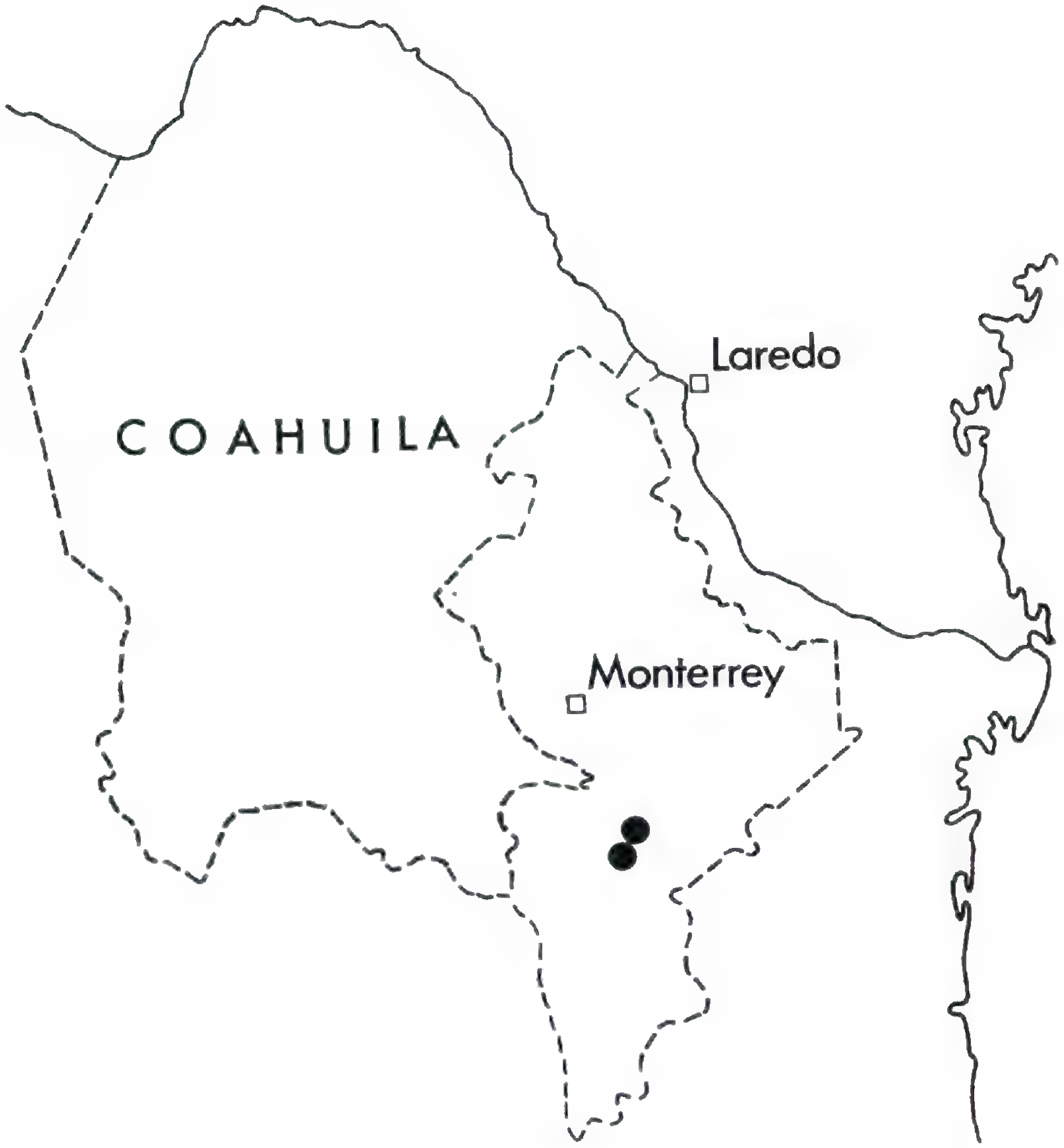


Fig. 4. *Phacelia vossii.* Habit and seed of plant.



Map 4. Mexico, States of Coahuila and Nuevo Leon. Range of *P. vossii.*

The flower color is not apparent in the specimens at hand, but the label of the type material indicates that it is a light purple. Other members of the *crenulata* group which possess a pale corolla are often also whitish at times.

This taxon appears to be related to *P. pinnatifida* Griseb. According to Brand (1913) the latter occurs in the Andes of South America in Peru, Boliva, and Argentina, from 3000 to 3800 meters. The specimens cited were identified as *P. integrifolia* Torr., however *P. vossii* is easily distin-

guished from the former by its evident perennial habit, pale more or less tubular corollas, smaller corrugated seeds and more densely pubescent herbage.

This species is named in honor of John Voss who revised the *crenulata* group in 1937.

Phacelia welshii Atwood sp. nov.

Plantae annuae, 1.0-4.5 dm altae; caules plus minusve flavo-virentes, simplices vel ramosi frondosi, hirsuti et dense tecti multi-cellularis stipitatis, glandibus; folia oblonga ad lanceolata, 1.5-8.0 cm longa, 0.5-2.7 cm lata, hirsuta et dense glandulifera, margines undulatae crenatae vel dentatae saepe revolutae, folia basales fasciculata, petiolata, petiolus 2.0 cm longus or minus, folia caulina sessiles vel fere sic, saepe cordata ad basim; inflorescentia cymarum scorpiodorum compositorum, terminalis ad extrema principalis caulis et rami lateralis, dense glandulifera et hirsuta, racemi individui congesta, sed laxe per fructus, usque ad 1.0 dm longa, pedicelli usque ad 1.5 mm longa; sepala spat lata glandulifere; corolla campanulata, purpurascens ad violacea, 5.0-6.0 mm longa et lata, pubescentia; anthera lutea; stylus exserta circa 8.0 mm, furcatus ¾ longitudo, inferna ¼ hirsutulosa et glandulifera; semina 4, oblonga, ventraliter brunnea ad prophyreus dorsale, foveolata, 2.8-3.4 mm longa, 1.3-1.5 mm lata, pagina ventrali pagina dorsalis pallidior quam et porcis prominentis, porca corrugata lata una, margines corrugatae et plus minusve revolutae.

TYPE: **Arizona:** COCONINO COUNTY: along highway 89 north of Gray Mountain, on red shale (also common south of town on red shale), 19 May 1970, *D. Atwood* 2608, (HOLOTYPE: BRY; ISOTYPES, ARIZ, ASC, B, BRY, CAS, COLO, DIX, GH, NY, POM, RM, RSA, UC, US, UT, UTC, WSC, WTS).

Additional materials examined: **Arizona:** COCONINO COUNTY: 2.5 mi w. of highway 89-64 jct, red shale, 19 May 1970, *D. Atwood* 2611, (ARIZ, ASC, B, BRY, CAS, COLO, DIX, GH, NY, UC, US, WSC, WTS); 10 mi n. of Wuptaki National Monument jct with highway 89, 19 May 1970, *D. Atwood* 2605, (ARIZ, ASC, B, BRY, CAS, GH, NY, POM, RM RSA, UC, US, UT, UTC, WTS); ca 1.5 mi n.w. of Headquarters of Wuptaki Na-

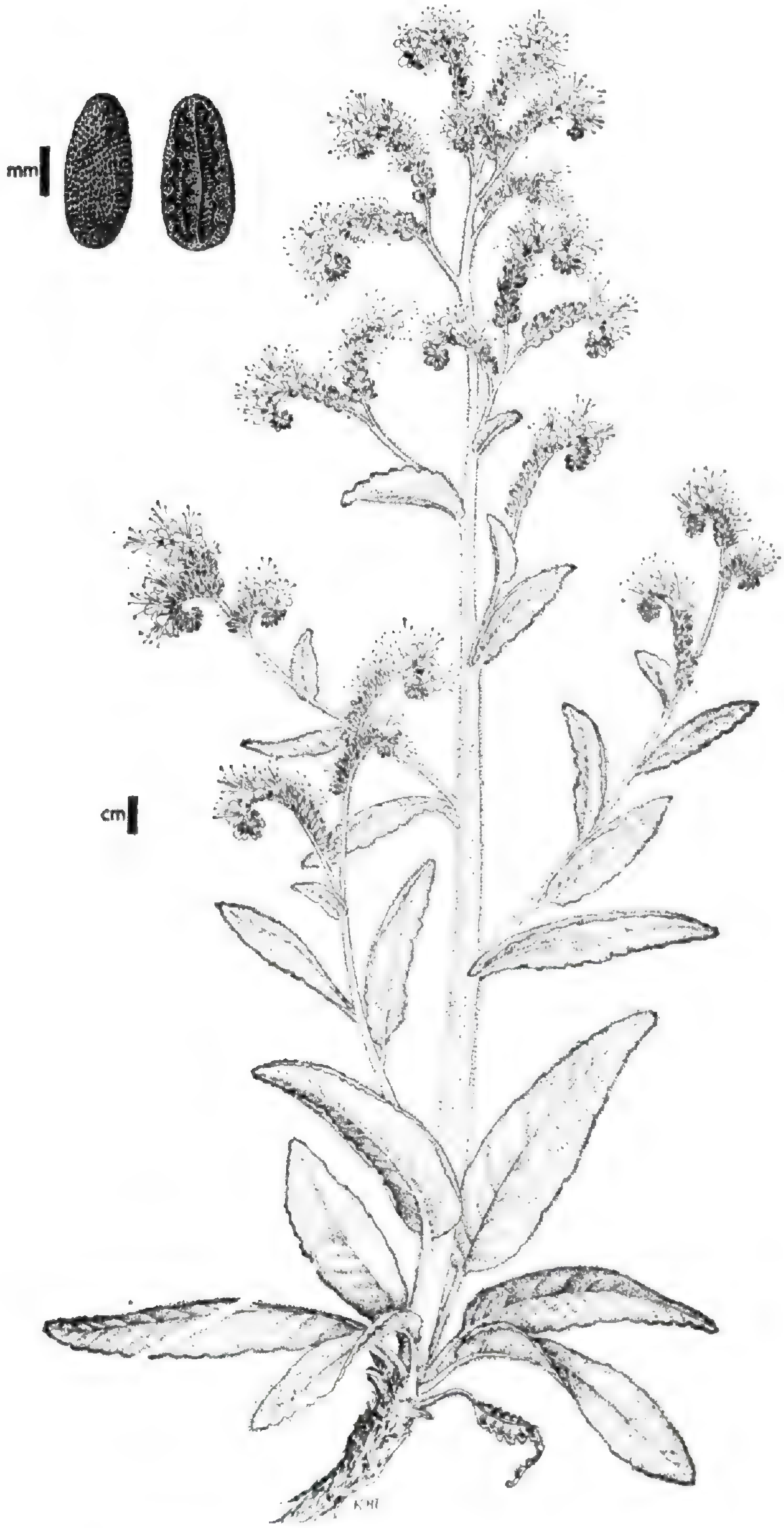
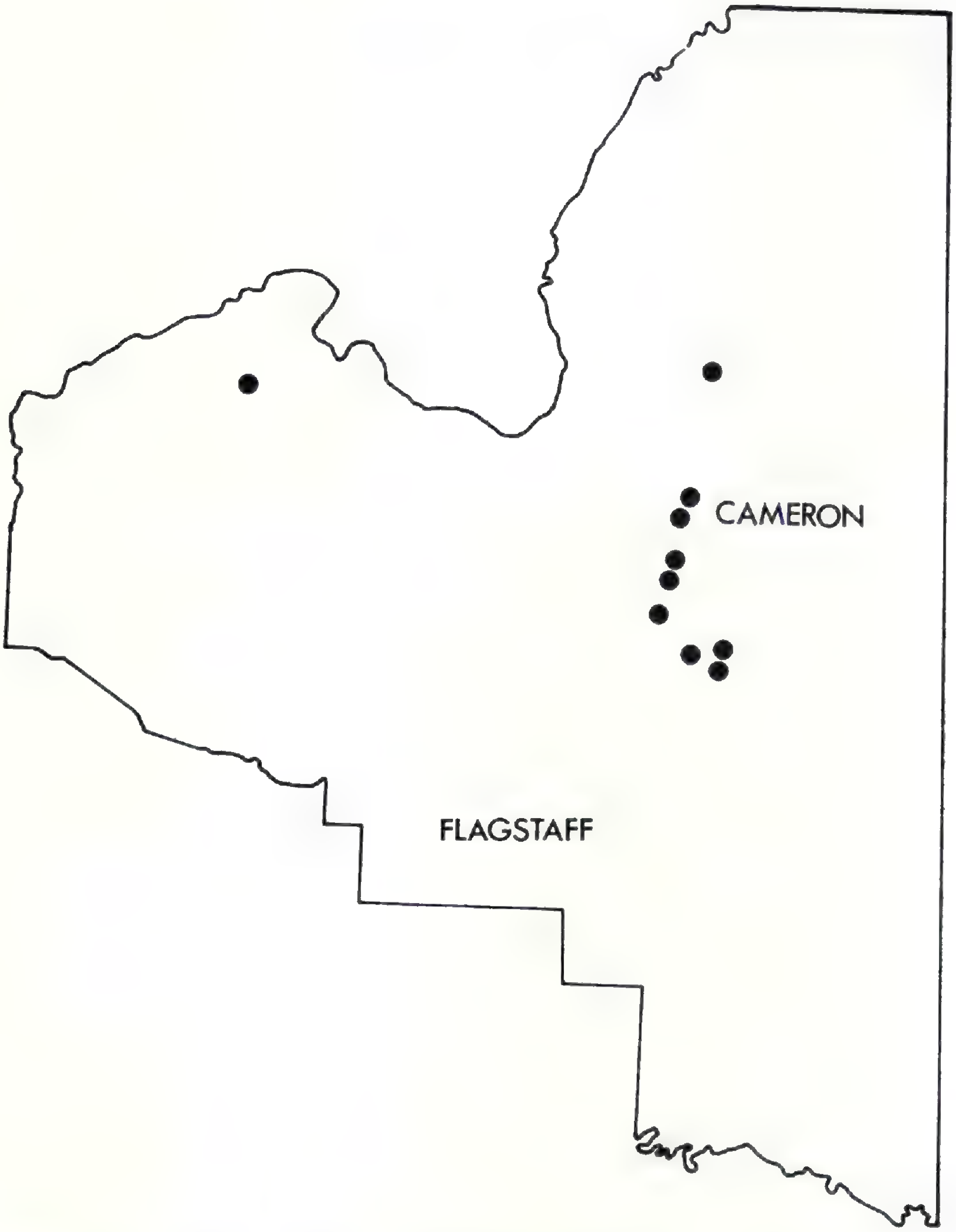


Fig. 5. *Phacelia welshii.* Habit and seed of plant.



Map 5. Coconino County, Arizona. Range of *P. welshii.*

tional Monument along highway on red shale, growing with *Ephedra*, *Hilaria*, *Oryzopsis*, blue grama, *Atriplex* and apache plume, 18 May 1970, *D. Atwood* 2601, (ASC, BRY, CAS, US, WSC); rocky limestone areas above the Little Colorado River, 6 May 1961, *D. Demaree* 44391, (CAS, UC); red shale hills along road ca 0.5 mi n. of headquarters of Wupatki National Monument, 18 May 1970, *D. Atwood* 2598, (ARIZ, B, BRY, CAS, COLO, DIX, GH, NY); Willow Springs n. of Cameron, 7 June 1942, *Ripley & Barneby* 4875, (CAS); red shale 11 mi s. of Cameron, 20 June 1948, *Howell* 24397, (CAS).

P. welshii (Figure 5, Map 5) is probably most closely related to *P. corrugata* and *P. utahensis*. It can be distinguished from the former by its broader, dark brown seeds, long (up to 1.3 mm long), flattened, multicellular, stipitate glands and different leaves. Typically *P. corrugata* is a more northern plant but is not uncommon in Coconino County. The new taxon can be differentiated from *P. utahensis* by its more open inflorescence, corrugated seeds, and broader, shorter, densely glandular leaves. *P. utahensis* is endemic to the Arapien Shale Formation in Utah.

This species is named in honor of Dr. Stanley L. Welsh, Brigham Young University, for his rich contributions toward the flora of the Intermountain area, and for his encouragement and invaluable help throughout the course of this study.

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REDISCOVERY OF TILIA NEGLECTA SPACH

HENRY K. SVENSON

Tilia neglecta has always been a questionable species of Linden. It was described in 1834 from "ambulacris Hort. Bot. Paris" and was stated to be of North American origin. The range is from Montreal to Washington and southwestward. Due to variability, and absence of a "type" with which the name could be correlated, it has remained one of the least tangible species in a taxonomically difficult

Fig. 1. Four views of *Tilia neglecta*, Sandy Neck, Cape Cod, Massachusetts.

genus. In Rhodora 72: 339-344. 1970, I described a "forest" of *Tilia neglecta* in a dune hollow on Cape Cod, Massachusetts (fig. 1), and reviewed its subspecific synonyms, but at that time I had not seen the fine treatment of the American species by G. N. Jones in Illinois Biological Monographs no. 39, 1968.

In the spring of 1970, on a visit to the herbarium of the *Jardin des Plantes* I found in the European folders a specimen of *T. neglecta* labeled in Spach's hand, dated 1834, and from the "Menagerie". Then, after making detailed sketches of this specimen, I went over to the western entrance of the zoological garden. Just a short distance within the gate and opposite the old viper pit, stood a gigantic weatherbeaten linden, which in its leaves corresponded exactly with the herbarium specimen, evidently the long-lost *Tilia neglecta*. There were no records, but Dr. H. Heine said that it was not a European linden, and suggested that the tree originated from seeds sent by Michaux, which would have produced flowers and fruit by 1834. From my visit in 1937 I remember vividly the rocky viper pit. These vipers are now in elegant quarters in the new reptile house, and the rocks are given over to some harmless snakes. The exhibit, I think, has suffered from wear, and there is a sign in French (a universal language) "Please do not throw stones at the snakes." At the opposite entrance of the "Menagerie" there is a large unlabeled tree of *T. heterophylla* of about the same vintage as *T. neglecta*.

In the summer of 1970 Dr. Heine made for me a fine series of herbarium specimens of the Menagerie tree (see fig. 2), showing foliage, flowers, and sprout growth. These I have given to the Gray Herbarium. They confirm in microscopic detail the *Tilia neglecta* specimen mentioned above, and Dr. Heine has labeled this tree as the "holotype". Accompanying the specimen to be retained by the Gray Herbarium, I have placed the detailed sketches I made of the 1834 specimen.

André Michaux (1746-1802) ranged far in the eastern United States. He had two stations for assembling seeds

Fig. 2. Leaf (upper surface) and flower cluster from the type tree of *Tilia neglecta* (Jardin des Plantes, Paris), × ca. 2/3 (actual size of leaf 11.5 × 9.5 cm).

and roots; one at Charleston, South Carolina, the other on the east bank of the Hackensack River at New Durham in New Jersey. An account of the New Jersey garden, which covered 8 or 10 acres now occupied by the Hoboken Cemetery, is given by Rusby in Bull. Torrey Club 11: 88-90. 1884. Zenkert in Flora of the Niagara Frontier Region, 1934 says that the younger Michaux (1770-1855), having on his first expedition (1801-1803) traveled in the territory west of the Alleghenies, during the three years of his second journey explored the Atlantic Coastal States from Maine to Georgia and made five trips to the interior, one

of which, undertaken in 1806 or 1807, took him from New York to Lakes Ontario and Erie. The Michaux Herbarium at Paris consists of selected plants to illustrate the "Flora boreali-americana" published in 1803.

The Paris herbarium is also well represented by other early collectors. In addition to the Michaux Herbarium, there are four folders of American lindens, in which there are many Michaux specimens. I saw in the third folder the specimen collected by W. Riehl in Missouri, labeled as *T. neglecta* by Spach. It was sent to Jones and correctly annotated as *T. americana*. Among the early collectors are Tuckerman*, Pearson, Cooper, Torrey, Oakes, and others. In the European folders are three additional sheets of *T. neglecta,* so named by Spach "fleurs 12 juillet, 1850; fr. Sept. 1851; cultivée dans les promenades de Carlsruhe (grand duché de Baden)". There are also the varieties of *Tilia* published by A. Braun. Both the American and European collections would be well worth going over. For help at the Jardin des Plantes I am also greatly indebted to the Director, Dr. Jean Jacques Leroy, and to Dr. Alicia Lourteig who has charge of the Michaux Herbarium.

To return to a survey of American Literature on the subject, we find that Hough, Handbook of Trees . . . (1907, and reprint 1947), says that *T. Michauxii* is similar to *T. heterophylla,* and also confounded with *T. pubescens*

*Edward Tuckerman (1817-1886) a graduate of Union College in Schenectady, was the first, and I think the only curator of their herbarium. In his fine classification of the genus *Carex,* published in Schenectady and dedicated to John Torrey, he mentions himself as "Mus. et Herb. Concord Cur.". While I was teaching at Union, I came upon a trunk or two filled with Tuckerman specimens, and wrote an account of Tuckerman in the Union Alumni Bulletin (about 1924). The plants consisted primarily of collections by Jonathan Pearson and Lewis Beck from the Schenectady region; plants collected by Tuckerman in Europe, chiefly in the Epping Forest of England; and a large series of European plants given to him by Grisebach. Of Tuckerman's *Carices* and other interesting plants of eastern America, I found none, and suppose that he took these collections with him on leaving Union. I understand that the Union College Herbarium is now dismantled.

Aiton, and not well understood. *T. neglecta* is not treated by Deam in Flora of Indiana, but L. Braun in The Woody Plants of Ohio (1961) publishes a map, and considers it "a wide-ranging species or species-complex, perhaps intermediate between *T. americana* and *T. heterophylla*, but not synonymous with either." House in Annotated list of the ferns and flowering plants of New York State, 1924, mentions *T. neglecta* as frequent in central New York; the lower Hudson River Valley, Long Island, and Staten Island. Wiegand and Eames in Flora of the Lake Cayuga Basin, New York, 1926, always careful in their judgments, note that "the pubescence on the lower surface of the leaf is highly variable, and on it several species have been founded. The pubescence, though always close, fluctuates very gradually in density, and no other structural characters occur. It seems better, therefore, to recognize this closely pubescent form as simply a variety, *T. americana* var. *heterophylla* Loudon. Sargent's *T. neglecta* is transitional to typical *T. americana*". Jones' detailed treatment recognizes only three species in eastern United States: *T. americana, T. heterophylla,* and *T. caroliniana.* Sargent, in Bot. Gaz. **66**: 494-496. 1918 states "I now consider *T. neglecta* to have been the *T. Michauxii* of Nuttall, which is the *T. argentea* of Michaux . . . The pubescence on the lower surface of the leaves is so constant and so persistent throughout the season, it seems best to consider it a species rather than a pubescent form of *T. glabra.* The base of the style in *T. neglecta* is furnished with long hairs, and that of *T. glabra* appears to be quite glabrous".

In the Paris tree the petals are 7.5 × 3 mm with narrowed base; the staminodia about 4.0-4.5 × 1.0 mm. In a microscopic comparison of the Cape Cod and Paris material, we see that the calyx is of the same shape, but in the Paris specimen the pubescence is not dense. Pedicels are thin and elongate, about 10 × 0.5 mm (see fig. 2) in the Paris material; but in the Cape Cod specimens densely stellate and about 4-5 × 0.7 mm. For pubescence of the under surface of the leaf, I have gone over the Cape Cod

material more carefully. Under a magnification of 40×, boiled fragments 2 mm square were cut with a razor blade directly on the 0.5 mm grid eyepiece. Simple hairs could then be readily counted for 1 sq. mm. The count of hairs or trichomes from an area, not dense, for 5 mm. square of lower leaf surface: 4-pronged 15-38 (10-25%); 3-pronged 1-6 (1-5%); 2-pronged (Malpighian) 6-10 (1%); 6-8-pronged (none); simple 100-150 (90%). This analysis (cf. the footnote on p. 343 of Rhodora, vol. 72) shows that there is a considerable amount of variation.

For the Paris tree (in several counts) there was an average of about 375 hairs on 5×5 mm of lower leaf surface: 4-pronged (5%); 3-pronged (1%); 2-pronged (3%); 5-pronged (less than 1%); simple (90%). In this Paris material the 2-pronged hairs are merely bifurcate; the simple hairs are mainly set at an angle on the veins, giving the veins a fuzzy appearance, whereas in the Cape Cod material the larger veins are practically glabrous.

As an excuse for this statistical treatment, I may cite the statement of Jones (p. 110) that much of the practical identification and classification of *Tilia* must be made on the amount and kind of pubescence, particularly on the underside of the leaves. Probably this statistical method is not the best one, but cutting and counting is not as difficult as it might seem. Perhaps the pattern of veining of the upper surface of the leaf would be more adaptable. At any rate, I have begun at the beginning, as Fernald would say, and the different opinions of capable botanists and the variations observed by them in these leaf structures, shows how difficult the subject is. I have accumulated notes and sketches of several specimens in the Paris Herbarium, and I have gone over casually the specimens of *T. neglecta* in the Gray Herbarium. I do not have the inclination to pursue the subject further. — Osterville, Mass. 02655.

THE ECOLOGY OF BENTHIC SALT MARSH ALGAE AT IPSWICH, MASSACHUSETTS I. ZONATION AND DISTRIBUTON OF ALGAL SPECIES

E. E. WEBBER AND R. T. WILCE

In a previous publication (Webber & Wilce, 1971) we treated the salt marsh algae at Ipswich in light of their occurrence, morphology, cytology, seasonal and reproductive periodicities, based on both field and laboratory investigations. In this paper the descriptive ecology of these plants is discussed.

The ecological nomenclature used to describe vertical and horizontal distributions of algae has varied considerably. Rather than adopt new terms describing the zoned character of the salt marsh algal vegetation, we have selected established terminology common to terrestrial ecological studies which applies also to flowering plants of the marsh environment (Weaver & Clements, 1938; Feldmann, 1951; Oosting, 1956; den Hartog, 1959). Accordingly, we have attempted to describe both the physiognamy and the vegetational units at each station, the latter in relation to their successional character.

Superficially, the zoned arrangement of an algal salt marsh vegetation often is not easily detected. The flat expanse of varying shades of green which cover the salt marsh surface contrasts sharply with the distinct and frequently colorful patterns of algal zonation of the rocky coast (see Frontispiece, Lewis, 1964). In order to discuss algal zonation and distribution at the Ipswich salt marsh, it was necessary to identify levels on the marsh surface with which to relate the presence and vertical range of algal species. Marsh phanerogams, owing to their abundance, distinctiveness, and regular and sharp zonation, served as reference points to this end. From the seaward edge of the marsh extending landward, the following seed plant associations

were recognized: *Spartina alterniflora* var. *glabra, Spartina patens, Spartina patens-Scirpus americanus* (or *Spartina patens-Distichlis spicata*) mixture, and *Juncus gerardi.* Algal zonation in the salt marsh becomes more apparent and more readily understood when studied in relation to the distribution of these phanerogams.

As stressed by Lewis (1964) and suggested earlier by the Stephensons (1949), a discussion of zonation along any shore should be based upon biological criteria, rather than relying strictly upon tidal limits. These limits may not be coincident with natural biological zones, especially when one considers the upper limits of vegetation in relation to tide levels. On shores exposed to wave action and spray, the distribution of those organisms which typically form the uppermost biological zones will be extended even higher than where a splash and spray zone are not present (c.f., Lewis, 1964, fig. 52). In the salt marsh environment at Ipswich, one encounters an approximation of a spray zone only near Station 1 (Webber & Wilce, 1971, p. 265); here, the presence of wood pilings provides a steep vertical face which contrasts with the gently sloping character of the surrounding marsh surfaces. This change in topography results in a stronger local wave splash, as compared with wave action on the marsh surfaces; thus, the upper distributional limit of *Calothrix crustacea,* for example, occurs at a higher level on these pilings than on the surrounding marsh. Therefore, using essentially biological criteria in relation to tide levels we recognize in the marsh environment a *sublittoral,* a *littoral,* and a less well defined, but nonetheless recognizable, *supralittoral* zone.

The sublittoral zone of the Ipswich salt marsh, when compared with the same zone characteristic of the open coast, is essentially non-existent. The marsh drains twice daily through a series of canals which, at low tide level, are mostly devoid of water. Where the marsh is closest to the sea and in the major trunk canals, water with salinity characteristics of open coastal water remains at low tide. It is in these salt marsh areas, the openings to the sea and

the major canals, where a true sublittoral zone can be recognized, and, correspondingly, a sublittoral flora.

We stress the fully marine character of the sublittoral benthic vegetation. Also, in our list of species from the Ipswich salt marsh (Webber & Wilce, 1971), we cite a number of taxa commonly represented in the marsh sublittoral as drifting plants, e.g., *Chaetomorpha melagonium* and *Phycodrys rubens*, to name but two; these plants, of variable longevity in the marsh environment, are transients from the open coast sublittoral. Their frequent appearance in the marsh sublittoral in conjunction with the attached marsh sublittoral vegetation is a manifestation both of the marine character of the marsh subtidal zone and the proximity of the marsh entrance to the open coast.

The littoral zone at the Ipswich marsh contains those organisms which are regularly submerged and exposed by the rise and fall of the tides. Biologically, this zone extends from the upper limit of the sublittoral, as indicated by *Fucus distichus* ssp. *evanescens*, to that uppermost portion on the shore populated by *Juncus gerardi*. Algae of the littoral zone show a zoned pattern of distribution as controlled by local factors of, e.g., habitat competition, availability of substrates, and topographic differences resulting in degree of exposure to insolation, desiccation, tidal action, and fresh water influence. These algal assemblages of predictable major constituents we interpret as associations, following Børgesen, 1905, Davis, 1913, Feldmann, 1951, Wilce, 1959, den Hartog, 1959 and Jorde Klavestad, 1963. However, as Chapman (1956) points out, one characteristic of salt marsh vegetation is its relative instability; thus, the term "associes" is a more apt designation of the vegetational status in these specific environments.

The supralittoral zone is characterized by those species which are predominantly terrestrial and which are not merely extensions of upper littoral marine species. The organisms which are regularly submerged and exposed by the tide are in fact, considered "maritime" (Lewis, 1964) rather than strictly marine. While a comparatively clear-cut dis-

tinction between those plants and animals of the upper littoral and those of the supralittoral may be possible on a rocky coast, this distinction is not always apparent at the Ipswich salt marsh. For example, *Calothrix crustacea* clearly occurs on the marsh surface (Station 1) in the upper littoral zone. In addition, this species along with the upper littoral green alga *Pseudendoclonium submarinum,* colonize wood pilings near Station 1. Owing to moderate wave splash on these pilings, both algal species extend vertically higher than the level of the surrounding marsh surface. Yet, at Ipswich, the position of *C. crustacea* and *P. submarinum* on the pilings near Station 1 is comparable to the position on the marsh surface populated by such terrestrial or "maritime" plants as *Juncus balticus* var. *littoralis, Panicum virgatum,* and *Solidago sempervirens.* Indeed, on the pilings with *Calothrix* and *Pseudendoclonium* one always finds the lichen *Lecanora chlarotera* which, according to Hale (personal communication), is not marine in its distribution, but rather is a common terrestrial species. Thus, the vegetation at this level is dominantly maritime-terrestrial, and does not represent solely an upward extension of the marine flora. We recognize, therefore, a supra-littoral zone biologically distinct in its composition of vascular plants and associated cryptogams which lies invariably immediately above the uppermost limit of salt marsh phanerogams, i.e., above *Juncus gerardi.*

ZONATION AND DISTRIBUTION OF ALGAL SPECIES

Before describing the species composition at each station, it is appropriate to identify and describe briefly the stations from which the algal collections and related data were taken (see also Webber & Wilce, 1971).

Station 1: typically marine, little influenced by fresh water runoff; shoreline a vertical mud bank with substratum consisting of mud, small stones, and the *Spartina* grasses; seasonal salinity range of 18-30°/oo.

Station 2: Similar to Sta. 1, but with a gently sloping

shoreline; substrates predominantly cobble, shells of *Midiolus demissa* and *Spartina* grasses.

Station 3: Tidal ditch outflow, 0.3-1 m deep, seasonally influenced by fresh water runoff; substrates of small stones and wood pilings; seasonal salinity range 3-33°/oo.

Station 4: Section of a major tidal creek beneath a highway bridge panning Fox Creek, moderately influenced by fresh water runoff; substrate mostly of stone and shell; seasonal salinity range 13-32°/oo.

Station 5: The innermost extremity of the Ipswich salt marsh, consisting of two substations due to the habitat character in the tidal creek in this region of the marsh; seasonal salinity range for both substations 0-27°/oo.

Substation 5a: A transect through the tidal creek near Northgate Rd. where at high water the bottom is covered to a depth of 0.6 m, and mostly exposed at low water; markedly influenced by fresh water runoff; substrates of small stones, mud, and plants of *Ruppia maritima*; this area is characterized also by a twice daily rapid flow of water.

Substation 5b: Differs from the latter by having a mud bottom, continual water cover at a 0.6 m depth, and a generally slow water displacement downstream.

Sublittoral zone:

Stations 1 and *2*. Species common to the sublittoral of these stations were not unlike those one might encounter in the sublittoral on a rocky coast. These algae included:

Enteromorpha intestinalis
Enteromorpha linza
Enteromorpha linza var. *oblanceolata*
Enteromorpha ahleriana
Enteromorpha clathrata
Enteromorpha flexuosa ssp. *flexuosa*
Enteromorpha flexuosa ssp. *pilifera*
Kornmannia leptoderma
Ulva gigantea
Chaetomorpha linum
Ralfsia verrucosa
Ralfsia clavata
Scytosiphon lomentaria

Petalonia fascia
Chorda filum
Laminaria saccharina
Dumontia incrassata
Hildenbrandia prototypus
Agardhiella tenera
Gracilaria foliifera
Gracilaria verrucosa
Chondrus crispus
Ceramium diaphanum
Ceramium rubrum
Ceramium rubriforme
Polysiphonia denudata
Polysiphonia lanosa
Polysiphonia nigra
Polysiphonia nigrescens

The majority of these species were of late spring and summer occurrence, while the following attained maximum vegetative and reproductive development during the winter and early spring months:

Enteromorpha linza var. *oblanceolata*
Kornmannia leptoderma
Ralfsia clavata
Ralfsia verrucosa
Scytosiphon lomentaria
Petalonia fascia
Laminaria saccharina
Dumontia incrassata

Conspicuous perennials at the sublittoral-littoral interface were *Fucus distichus* ssp. *evanescens, Fucus vesiculosus* and *Chondrus crispus.*

Station 3: There was a decrease in numbers of sublittoral species at Station 3 as compared with Stations 1 and 2. This reduction in taxa is due likely to the comparative lack of rocky substrate, the pronounced fresh water influence in the winter and spring months, and the shallow water at this station. Those algae common to the sublittoral of *Station 3* throughout the summer were:

Enteromorpha intestinalis
Enteromorpha flexuosa ssp. *pilifera*
Ulva rigida
Cladophora liniformis
Bryopsis plumosa
Ceramium diaphanum
Ceramium fastigiatum
Polysiphonia denudata

The winter and early spring algal vegetation was dominated by four species:

Kornmannia leptoderma
Scytosiphon lomentaria
Petalonia fascia
Melosira juergensii

The only sublittoral perennials in this station were *Ralfsia clavata*, *Ralfsia verrucosa*, and *Chondrus crispus*.

Station 4. The submerged algal vegetation here was scant. From November through March *Kornmannia leptoderma*, *Pentalonia fascia*, and *Dumontia incrassata* comprised the macroscopic algae at this station in the sublittoral zone. These taxa were continually vegetative and greatly reduced in size, as compared with their larger and normally reproductive counterparts at *Stations 1-3*.

The sublittoral perennials were the same as those at *Station 3*, i.e., *Ralfsia clavata*, *Ralfsia verrucosa*, and *Chondrus crispus*.

Station 5, a and *b.* The vegetation in the sublittoral here had the smallest number of algal species of any station. We have considered this to be a reflection of the reduced salinities occurring here through most of the year. During the spring and autumn, the following species dominated:

Capsosiphon fulvescens
Enteromorpha intestinalis
Polysiphonia urceolata
Ectocarpus confervoides var. *dasycarpa*

In early spring only the stalked diatom, *Gomphonema olivaceum*, constituted the macroscopic algal vegetation, covering the numerous small stones in this tidal creek. Owing to a thick ice cover, samples of winter algae were not obtained from this station.

Littoral Zone

Stations 1 and *2*. *Fucus vesiculosus* and *Ascophyllum nodosum* occurred in the littoral zone wherever stone, rock, or other solid substrate was present. The landward extent of these species differed, however, between *Stations 1* and *2*. For example, at Station 1 the marsh surface is essentially 1 meter higher above high water neap tide levels than is that of *Station 2*, owing to the presence of a vertical mud bank at the former station. *Fucus vesiculosus* became established on this bank, the plants extending about 3/4 of the height of this vertical surface. At this

uppermost level, *Fucus* thalli tended toward a spiral growth habit, and they were smaller than those plants in the mid-littoral. By contrast, the lower level and more sloping topography of *Station 2* resulted in both *Fucus* and *Ascophyllum* extending onto the marsh surface, where they developed as typical marsh fucoids, i.e., *F. vesiculosus* var. *spiralis* and *A. nodosum f. scorpioides,* both at the bases of *Spartina alterniflora* var. *glabra.*

Immediately beneath the seaward marsh edge, a dark green algal zone, the *Enteromorpha* associes (Fig. 1), was conspicuous on the mud at both stations. The summer and autumn algae comprising this associes were:

Enteromorpha ahlneriana
Enteromorpha flexuosa
ssp. *paradoxa*
Enteromorpha prolifera
Percursaria percursa
Cladophora sericea
Rhizoclonium riparium
f. *riparium*
f. *validum*

Throughout the winter and spring months this *Enteromorpha* associes assumed a pronounced brown hue owing to increased numbers of *Pylaiella littoralis,* with lesser amounts of *Ectocarpus confervoides* var. *arcta.* Associated with these plants at this time were irregularly distributed clusters of:

Enteromorpha flexuosa
ssp. *paradoxa*
Monostroma oxyspermum
Percursaria percursa
Vaucheria intermedia

Covering the mud in the Spartinetum alternifloretum at Station 1 were conspicuous green tufts of *Rhizoclonium riparium* (f. *riparium* and f. *polyrhizum*), *Rhizoclonium implexum,* and *Vaucheria intermedia.*

While these algae were similarly located at *Station 2,* their distribution at the latter station was limited to the more seaward edge of the Spartinetum. We attribute this local restriction in vertical distribution to competition for habitat; marsh fucoids and the ribbed mussel, *Modiolus demissa,* thoroughly blanketed much of the available mud substrate beneath *Spartina alterniflora* var. *glabra,* thus

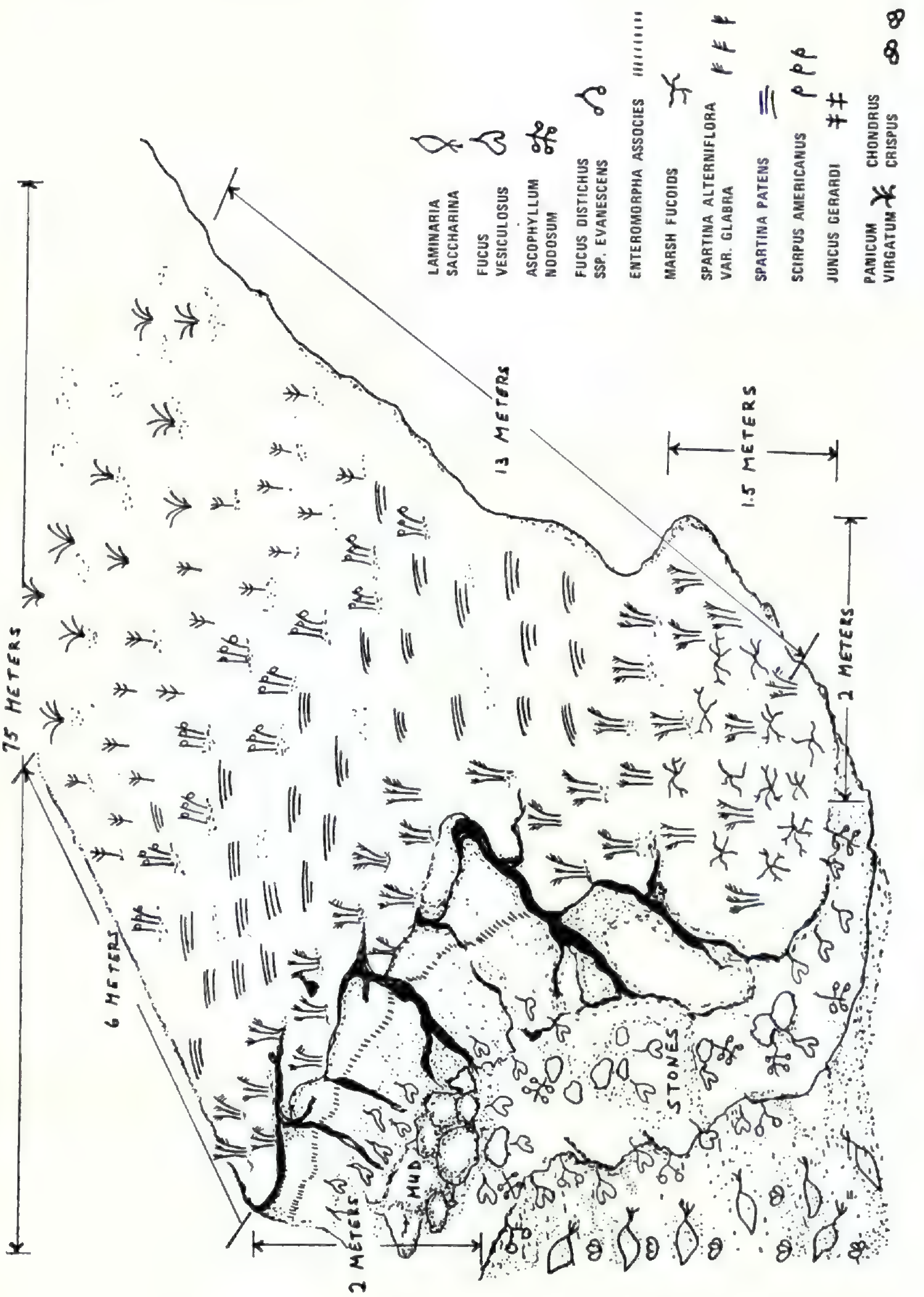

Fig. 1 SEGMENT OF SHORELINE ALONG CASTLE NECK RIVER

prohibiting any further upshore spread of *Rhizoclonium riparium, R. implexum,* and *Vaucheria intermedium.* A variety of filamentous bluegreens was collected throughout the year from the mud of this Spartinetum at both Stations 1 and 2 (Webber, 1967).

Moving landward, the next algal associes occurred beneath *Spartina patens* and consisted almost entirely of *Vaucheria arcassonensis* (Webber, 1968). Growth of this alga, with lesser amounts of *V. intermedia,* was particularly evident during the summer and autumn months, forming dense, felt-like mats on the soil. Numerous filamentous bluegreens also were common at this time on the sandy peat soil of the Spartinetum patentis.

Old culms of *Spartina patens* were epiphytized throughout the year mainly by *Calothrix confervicola,* as tufts to 3 mm tall. Often entangled with *C. confervicola* were plants of *Microcoleus tenerrimus*; the latter species never occurred alone as a dominant. Blum (1968), working on several Cape Cod (Massachusetts) marshes, concluded that a species of *Calothrix* (likely *C. confervicola*) is the most important colonizer in the moist micro-habitats on dead *S. patens* culms. He also demonstrated a marked interdependence between specific salt marsh grasses and their underlying algal species. Blum further elucidated the relationship between the mature form of the graminoid zone and such environmental parameters as light penetration and intensity in the zone, filtration and detritus retention, and drainage, as all these events are influenced by the morphology of a specific stand of grass.

The brownish-green tubular thalli of *Capsosiphon fulvescens* were present also in the Ipswich Spartinetum patentis. While mocroscopic individuals of this species were epilithic in the sublittoral at Substation 5a (Webber & Wilce, 1971, p. 269), the macroscopic thalli of *Capsosiphon* (the type commonly encountered elsewhere) grew only in a single, small, water-retaining marsh depression at *Station 1.* The discovery of two populations of *Capsosiphon,* distinctly different in their morphologies, seasonality, and

habitat requirements, suggests further questions as to the character of the species and the role of the environment in determining the expression of that character. Laboratory and field experiments designed to elucidate this matter are forthcoming.

The highest band of salt marsh phanerogams at Stations 1 and 2 was the *Juncus gerardi* association; the bases of *Juncus* and its associated algal species were wetted by sea water only during periods of spring tides. The algal vegetation on the sandy soil here was predominantly *Tolypothrix tenuis* and *Rhizoclonium riparium* f. *validum*. On patches of soil not colonized by *Tolypothrix* and *Rhizoclonium*, *Calothrix crustacea* formed brownish-blue masses throughout the year, being especially abundant during the autumn, winter, and spring months.

Station 3. The littoral zone of Station 3 consisted of portions of the marsh surface and several wood pilings located in the outflow of the tidal ditch at this station. Bright green patches of *Pseudendoclonium submarinum* were always apparent, occurring essentially in the top 20 cm of these pilings throughout the year. *Monostroma oxyspermum* occurred just beneath *P. submarinum* on the pilings' surfaces; this species first appeared in September as small foliose clusters, and developed abundantly throughout the winter until late April, after which it was no longer apparent at this station. The lowermost extent of *M. oxyspermum* coincided with low water neap tide levels. *Ulothrix subflaccida,* mixed with *Monostroma,* was first evident in December, and most common during the spring months. Similar to *M. oxyspermum, U. subflaccida* was absent during the summer (July through September).

The algal vegetation of the marsh littoral at Station 3 consisted of few species; these were *Vaucheria intermedia, Rhizoclonium implexum, Percursaria percursa,* and a mixture of filamentous bluegreens. It was quite similar in its species composition to the associes of comparable zonation at Stations 1 and 2, being essentially a telescoped version of the same zone at these stations.

Station 4. Wooden bridge supports over Fox Creek and the small stones and larger rocks in the creek bed immediately beneath the bridge were substrates in the littoral zone of this station. A scant algal vegetation characterized the littoral zone here, with only *Pseudendoclonium submarinum* and a few filaments of *Calothrix crustacea* apparent on the bridge supports through the year. *Ralfsia clavata* and *R. verrucosa* were yearly inhabitants also, as epilithic crusts in the most damp and most shaded areas of the creek bed along with large quantities of the barnacle, *Balanus balanoides*. The creek bed and that portion of the littoral zone with *Pseudendoclonium* and *Calothrix* could also be characterized as the *Balanus* zone. *Balanus* was present on virtually all solid substratum at this station, and was the dominant competitor for substrate colonization. Perhaps this is the reason for so few species of attached algae here. In other upper shore locations one usually finds numerous algal species in the *Balanus* zone. While the obvious factors contributing to this associes of so few species appear to be competition for substrate, exposure to insolation and to desiccation, the specific ecological factors responsible for this causal relationship are yet to be discovered.

Station 5, a and *b.* The littoral zone of Station 5 consisted of muddy tidal creek banks which contained an algal flora throughout the spring, summer, and autumn months of *Vaucheria compacta* var. *koksoakensis* mixed with filamentous bluegreens.

Owing to an uneveness in the creek bed coupled with an irregular accumulation of variously sized stones, a segment of *Substation 5a* drained completely at low tide. Thus, a small and well-defined littoral region was present in the bed itself. Small stones here were covered with attached plants of *Monostroma oxyspermum* from September through December. This species also was encountered at *Stations 1-3* from late October through the winter, persisting until June. Conover (1958) reported a similar autumn-winter (October to January) reoccurrence of *M.*

oxyspermum in addition to its spring (March to June) growth in Great Pond Estuary, Massachusetts. His data shows comparable spring and autumn light intensities, and he suggested this factor as responsible for his observed pattern of seasonal distribution. While Conover's hypothesis might well be involved in an explanation of the presence of *M. oxyspermum* in *Substation 5a* at Ipswich, our field data indicate that salinity levels may also affect the seasonal appearance of these plants. Salinities at *Substation 5a* during the September to December period ranged from 25-27°/oo, a variation similar to that, 24-30°/oo, measured at *Stations 1-3* during the period of maximum spring growth of *Monostroma oxyspermum.* Thus, the seasonal patterns of occurrence of this species at Ipswich coincide with low light intensities and high salinity levels.

Winter collections were not possible at *Station 5* because of a thick ice and snow cover.

Supralittoral zone.

This zone was recognized only in conjunction with the wood pilings near Station 1. The algal vegetation which occurred in and on these pilings was uniform in species composition throughout the year, and consisted of:

Pseudendoclonium submarinum
Calothrix crustacea
Schizothrix calcicola
Urococcus foslieanus
Branched filamentous Chrysophyte undescribed

SUMMARY COMMENTS

In this paper we have attempted to summarize our descriptive ecological data in an overview interpretation of the ecology of the salt marsh algae at Ipswich. The algal taxa are characterized relative to their horizontal and vertical zonation on the marsh, and the seasonality of the dominant species is described.

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LUPINUS MEXICANUS CERV. EX. LAG.

David B. Dunn

Since *Lupinus mexicanus* Cerv. ex. Lag. (1816) was the first taxon in the genus *Lupinus* named for Mexico it is imperative to determine which lupine the name was applied to. As the earliest name it would take priority over all the later names. In all of Charles Piper Smith's works on the lupines of Mexico he literally ignored the name. In my own studies it has been a perplexing problem for quite a number of years. The curator of the herbarium at Madrid, Spain, searched, but was unable to locate a specimen of *Lupinus mexicanus* of any vintage. Since seeds were sent to England by Lagasca, and the plants grown were utilized to prepare a much more detailed and accurate description for Edwards Botanical Register (no. 457, in 1820) than that originally provided by Lagasca, Dr. Walters at Cambridge, England, also searched the herbarium there but was unable to find a specimen of the material used in either of the original descriptions provided by Lagasca and Edwards. In 1832, Maund was attempting to identify *Lupinus mexicanus* and stated that the species had been lost to science, but that he thought that it had been regained. He supplied an illustration as had Edwards. Edwards suggested that *L. mexicanus* was probably a biennial and that it had flowered in the "stove" (glasshouse) in February, which suggests that they had planted the seeds the previous season, but flowering had not occurred until February. Maund's plant material is indicated as a perennial, which was probably another taxon, and nothing is given which helps identify *L. mexicanus*.

The curators of the herbaria of Kew, Paris, Berlin, Zurich and others searched but were unable to find any specimens of the period involved. Since there is apparently no type specimen and since the description of Lagasca could apply to several taxa it is necessary to select some element to fix the application of the name until such time as an

authentic specimen may be discovered. The illustration in Edwards Botanical Register (no. 457, 1820) serves this purpose and I select it to serve in lieu of a type specimen for *Lupinus mexicanus* Cerv. ex Lag. It should also be pointed out that there is no accurately labeled material of *Lupinus mexicanus* in any of the herbaria and the material distributed by Pringle as *L. mexicanus* has been a major source of error, since he applied the name to, at best, a variant of *L. aschenbornii,* which is an alpine perennial.

During the preparation of the treatment of *Lupinus* for the "Flora de Valle de Mexico" (for Dr. Rzedowski) the lupines of the area have been studied in considerable detail. Several field trips to the area have been conducted and numerous collections made. Among the collections are plants collected along the toll road between Mexico City and Queretaro, the latter, the site of the palace of the Emperor Maximilian. This route is probably not far from the original route the Spaniards traveled, since it is on the most direct route between the two early cities. In the area near Tula, a number of collections of lupines were made, which closely match the detailed description in Edwards Botanical Register. The collection made in July by Giles Waines contained both flowering and fruiting specimens. Plants collected along the toll road a few miles northwest of the Tula turnoff by both Harmon and Dunn on three different years in late December were in full fruit, as well as having a few branches in flower. Seeds from both the Waines collection and the Dunn collection were grown in the research greenhouse at the University of Missouri. What had been assumed to be the same taxon turned out to be two different taxa of the same complex — one an annual flowering in the fall and early winter and the second a biennial germinating at the same time as the annual but requiring cold treatment during the winter before flowering the following season. By planting the seeds of the annual in January and the biennial in the early fall of the previous year the two were brought into flower at the same time. Attempts to self-pollinate the biennial all failed, so the

taxon is obligate outcrossing. Most of the attempts to cross the annual and the biennial failed but a few produced some seeds. Thus there are two distinct breeding populations isolated primarily by their phenology, which remain distinct in nature, but which have not fully achieved intersterility, which is not uncommon in plants. After becoming aware of this difference, the colonies along the toll road were examined and found to contain many plants with only caespitose clusters of basal leaves with no flowering shoots, in late December, while the annuals were in fruit with the lateral branches still in flower. The biennial is *Lupinus mexicanus* and the annual is *Lupinus bilineatus* Benth.

The following translations of the Latin descriptions of both Lagasca and Edwards are given for determining the identity: "288. *Lupinus mexicanus* Cerv. ex. Lag. Gen. et Sp. Nov. 22, 1816.

Calyces alternately bracteolate (appendaged) upper-lip semibifid, lower lip obscurely tridentate.

Lupinus mexicanus Cerv., near *L. termis* L.

Leaves ternate at the base, remains of 5-7 leaflets; leaflets lanceolate, mucronate, upper surface glabrous, lower surface pilose. Stipules setaceous, pilose as the stems. Peduncles opposite the leaf, spicate-racemose above. Bracts setaceous, deciduous. Flowers alternate (scattered), short stalked, blue. Calyx bracteoles setaceous, short. Legumes pilose.

Habitat in New Spain (Mexico). Seeds sent with D. Vincent Cervantes."

From Edwards Bot. Reg. 457. 1820, the following translation: (Note, familial and generic portions are not given and interpretations are included in parentheses). "Plants, except for the corolla, entirely shaggy-pilose. Leaflets 3?-5?, 7-8, elongate-cuneate, narrow, short pointed, tapered for a considerable way down, glabrous above, rendered white beneath by shaggy-pilose pubescence, longest about 2 inches, shorter than the long-piled petioles; stipules linear-subulate, erect, long-piled. Racemes elongate spicate, laxly many-flowered, flowers scattered, sparse, la-

vender to purplish-blue, with darker streaks (veins), bracteose before anthesis; peduncles opposite the leaves (true of all lupines that have the top lateral bud elongate as a branch); pedicels hirsute, shaggy, ascending, shorter than the calyx, bracts linear-sublate, very narrow, filiform, longer than the calyx, caducous. Calyces shaggy-hirsute, green, with divaricate lips, the upper spilt at the end into a notch. Banners folded, reflexed, astride the upper margins of the wings by a deep sulcus; wings hatchet shaped, pointed, cohering by the front edges; keels pale ascending upward, narrow subulate-falcate, as long as the wings; with a long deep-purple tapered point, — etc."

The distinctive traits from which *L. mexicanus* can be determined are the shaggy-pilose hairs, the upper surface of the leaflets glabrous, while the lower is shaggy-pilose, and the corolla is glabrous as intimated by Edwards, the long setaceous bracts and short setaceous bracteoles at the lateral sinuses of the calyx, the shaggy-hirsute pedicels, the deep sulcus of the banner, the narrow subulate-falcate keel with the long tapered point, and Edward's term of pointed hatchet-shaped wings. His discussion of flowering time and suggestion that the taxon is a biennial apply. The field location is that of the most direct route between the two early major cities of that time. All of the traits apply to the biennial plant material collected by Giles Waines. The greenhouse plants grown from seed more closely resemble the illustration provided in Edwards, as would be expected, since greenhouse plants were used in preparing the description. The field material, in nature, has denser foliage and a denser raceme, which would represent the effects of high light intensity at high elevations.

The specimen collected by *Giles Waines* Lupin #2 (UMO-88263) (Fig. 1) is considered as typical material of *Lupinus mexicanus* Cerv. ex. Lag. A field duplicate has been sent to Madrid (MA) and a duplicate grown in the greenhouse has been sent to Cambridge (CGE); others will be distributed as available. The close relatives are *Lupinus bilineatus*

Figure 1. A field specimen of *Lupinus mexicanus* Cerv. ex. Lag., a biennial collected in July by *Giles Waines*, Lupine #2 (deposited at UMO; duplicate sent to MA; a greenhouse grown duplicate sent to CGE).

Benth (1839), *L. hartwegii* Lindl. (1839), and *L. persistens* Rose (1905).

The taxon which has been misinterpreted as *Lupinus mexicanus* by several authors is *Lupinus aschenbornii.* While the latter taxon has glabrous flowers and a glabrous upper leaflet surface and pilose hairs, the hairs do not match Edward's term of shaggy nor are the leaflets shaped right nor is the keel slender, long-falcate. The keel is almost straight on the upper edge and the banner is narrow and without the deep sulcus. In addition *L. aschenbornii* is alpine and it is a perennial, which goes dormant every winter. It is a most unlikely candidate for a greenhouse plant or a plant that could be grown outside in Madrid, Spain, at the Botanical Garden. In addition the flower size and shape are entirely wrong for the material illustrated by Edwards from seeds sent by Lagasca.

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NOMENCLATURAL AND TAXONOMIC NOTES ON MEXICAN COMPOSITAE

Rogers McVaugh

The following notes have accumulated during the preparation of a treatment of the family Compositae for a proposed *Flora Novo-Galiciana.* Included are one new combination, discussions of points of nomenclature, mention of notable range-extensions, and comments on taxonomic decisions, all of which are somewhat out of place in a formal floristic treatment. The area covered by the proposed flora includes the Mexican States of Jalisco, Colima, and Aguascalientes, and some adjoining territory; for a fuller description of it see Brittonia 13: 145-147. 1961, Contr. Univ. Mich. Herb. **9**: 1-7. 1966, or Contr. Univ. Mich. Herb. **9**: 207-357. 1972. Another paper preliminary to the *Flora Novo-Galiciana,* including descriptions of a number of taxa of Compositae new to science, appeared in Contr. Univ. Mich. Herb. **9**: 359-484. 1972. For general support of the field-work and other activities on which this paper is based, I am grateful to the National Science Foundation (Grant no. GB-5218X).

In the course of revision of the various groups of Compositae for the Flora, I have seen most of the relevant types (or in some instances isotypes). When I have seen and studied a specimen, this is indicated in the text below in the conventional way [!]. To the many persons and institutions that have permitted and assisted my studies of the valuable collections in their charge, my sincere thanks.

Many of the remarks on nomenclature refer to the names published by Kunth in the fourth volume of *Nova Genera et Species Plantarum* (1818), or those published by De-Candolle in the fifth and sixth volumes of his *Prodromus* (1836, 1838). To the authorities at Paris, where I have studied most of the types of Humboldt & Bonpland, and at Geneva, where similarly I have seen and studied the types of DeCandolle, I am most grateful.

It is necessary to comment on the dates of publication of the fourth volume of the *Nova Genera et Species,* which dealt wholly with the Compositae. Folio and quarto editions of this were published simultaneously (as they were for the other 6 volumes of the set). Volume 4 appeared in 1820, in 5 installments, on 17 Apr, 22 Mai, 31 Jul, 18 Sep and 26 Dec, respectively. Apparently the quarto edition was not available to the public before these dates, nor was the folio edition generally distributed. The printing of the folio text was completed, however, in September 1818, and at least 4 copies were distributed and became more or less accessible to the botanical public by 1 December 1818. The authors presented a copy to the Institut in Paris on 26 October 1818. Under the code of nomenclature now in force, this constitutes effective publication as of that date, of all the new names proposed in the volume. The fact that the authors considered the work unpublished until it was generally distributed in 1820, is irrelevant. In citations of names published in the *Nova Genera et Species,* botanical custom has been to cite the page-numbers of the quarto edition, as this has been more generally available. Some authors have cited the pages of both quarto and folio editions, on the assumption that the two were published simultaneously. Names of Compositae, however, are correctly cited as from the folio edition only, because publication of the quarto pages was delayed for a year and a half to two years. For summary of the dates of publication of both editions and the circumstances surrounding the distribution of volume 4, see Stafleu, F., *Taxonomic Literature* (Regnum Veg. 52: 225-226. 1967). Many of the circumstances were first made public by Henri Cassini, who was given a copy of the folio text by Kunth, and who criticized it in his own published articles before the dates of general distribution in 1820. Cassini's remarks, originally published in the *Journal de Physique, de Chimie, d'Histoire Naturalle et des Arts,* early in 1819, were reprinted in his *Opuscules Phytologiques,* vol. 1, pp. 324, 339, etc. 1826.

Ageratella microphylla (Sch. Bip.) A. Gray in S. Wats. Proc. Am. Acad. 22: 419. 1887.

Ageratum microphyllum Sch. Bip. in Seem. Bot. Voy. Herald 298. 1856.

Ageratella microphylla var. *seemannii* and var. *palmeri* A. Gray in S. Wats. Proc. Am. Acad. 22: 419. 1887.

Ageratella palmeri (A. Gray) Rob. Proc. Am. Acad. 41: 272. 1905.

The type of *A. microphylla* (from the "Sierra Madre", i.e. perhaps from Cerro del Pinal, Sinaloa, *Seemann* 2043!, at K) was taken from a plant with unusually broad leaves, as well shown in the illustration published by Hemsley (Biol. Centr. Am. Bot. 5: *pl. 42*. 1881). The specimen evidently represents a portion of a plant in which several long leafy branches arose from a larger stem. As is often the case in the Compositae, the leaves are opposite at the lower nodes of such branches, but sometimes alternate above. Similarly abnormally branched specimens, of otherwise typical *"palmeri"*, have the same leaf-arrangement but with fewer opposite leaves (e.g. *Gaiser* 62, at MICH, from near Guadalajara). Nothing exactly like the type of *microphylla* has been found by any subsequent collector, and we can but surmise what it may represent, until it can be found again in the field.

Gray (1887) distinguished what he called two varieties on the basis of the broad, incised-dentate leaves and subspicate inflorescence of var. *seemannii* (i.e. typical *microphylla*), and the narrow, subentire leaves and looser inflorescence of var. *palmeri*. Robinson (Proc. Am. Acad. 41: 271-272. 1905), and Blake, in the *Trees and Shrubs of Mexico,* noted these features, and stated also that the leaves were alternate in *palmeri* but opposite in *microphylla*. Both these authors treated the two taxa as distinct species. Blake's key is based entirely on leaf-characters. In fact it seems that neither position nor shape of leaves is completely diagnostic. In the original specimens of var. *palmeri* (*Palmer* 537!, at GH, from near Guadalajara), and in most

flowering specimens, the narrow leaves of sterile axillary shoots are much in evidence, giving the impression of a narrow-leaved plant. There is much individual variation in this respect, but the main cauline leaves subtending axillary shoots are seldom very narrow, and often much toothed or lobed.

The differences between "spikelike" and "loose" inflorescences also appear to be related to individual differences in branching. When vigorous lateral leafy branches (e.g. those 10-30 cm long) produce a number of short-peduncled axillary clusters of flower-heads, the effect is of a spike; when (as in most specimens), the lateral branches are reduced in length, and in number of nodes, and bear few or no heads except small clusters at the tips, the effect is of a small loose panicle. Various intermediates can be demonstrated.

Archibaccharis hieraciifolia Heering, Jahrb. Hamburg. Wiss. Anst. 21, Beih. 3: 40. 1904.

Baccharis hieraciifolia Hemsl. Biol. Centr. Am. Bot. 2: 129. 1881, not *B. hieracifolia* Lam., 1783.

Hemibaccharis hieraciodes Blake, Contr. U.S. Nat. Herb. 20: 547. 1924.

Archibaccharis hieracioides (Blake) Blake, Jour. Washington Acad. Sci. 17: 60. 1927.

Blake (1927) discussed the nomenclature of this species and that of *Archibaccharis hirtella*. Both were assigned names by Heering in 1904, but both were called "n.spec." in spite of the fact that both names were derived from previously published names. As Blake said, "it seems advisable to treat these two names of Heering as representing new combinations". Under the International Code of Botanical Nomenclature (Art. 72) a new combination derived from a previously published but illegitimate name (e.g. *Archibaccharis hieraciifolia* from *Baccharis hieraciifolia* Hemsl.) may be treated as a new name. It is therefore proper to use the name originally proposed by Heering, not *Archibaccharis hieracioides*, the substitute proposed by Blake.

Baccharis sulcata DC. in DC. Prodr. **5**: 419. 1836.
Baccharis potosina A. Gray, Proc. Am. Acad. **15**: 33. 1879.

Blake (in the *Trees and Shrubs of Mexico,* 1926) treated *Baccharis sulcata* as a synonym of *B. thesioides* H.B.K., but the type of *B. sulcata* (Villalpando, *Méndez*! in G-DC) certainly represents another species. The narrow leaves (up to 3-3.5 mm wide) vary from quite entire to toothed, with up to 4 or rarely 6 short teeth per cm of margin. In other respects, including the characters of heads and inflorescence, and the habit, the plants are typical of what has been called *B. potosina* (San Luis Potosí, *Parry & Palmer* 410! at GH, the type).

Bidens acrifolia Sherff, Bot. Gaz. **94**: 591. 1933.
Bidens polyglossa Sherff, Brittonia **16**: 61. 1964.

Southern Sinaloa (Concordia, *Dehesa* 1532!, K, the type), and western Jalisco (northwest of Cuautla, *McVaugh* 13633!, MICH, type of *B. polyglossa*).

The type of *Bidens acrifolia* is an immature and incomplete specimen, but in all observable details it agrees precisely with the abundant available material of *B. polyglossa.* The apparent differences mentioned by Sherff (Brittonia **16**: 62. 1964) are insignificant or (those pertaining to the leaf-pubescence and to the phyllaries) nonexistent.

Chaptalia runcinata H.B.K. Nov. Gen. & Sp. 4 [ed. fol.]: 5. *pl. 303.* 1818.

Sonora (*Pennell* 19647), western Durango (*Maysilles* 7452, 7809, 7848; *Cronquist* 9560), northern Nayarit (*Rose* 2022, at US). Costa Rica; Venezuela and Colombia (*Humboldt & Bonpland*!, at P, the type); Bolivia to southeastern Brazil and northern Argentina. Not previously reported from north of Costa Rica, but abundant on the summer-wet, high pine plains of western Durango (cited specimens from Sonora and Durango all at MICH). The seasonal forms with reduced or filiform marginal flowers, reported by Burkart for South American representatives of this species, have not been found in Mexico, but otherwise the

Mexican material agrees perfectly with that from further south.

Conyza viscosa Mill. Gard. Dict. ed. 8. *Conyza* no. 8. 1768.
Conyza lyrata H.B.K. Nov. Gen. & Sp. 4 [ed. fol.] : 55. 1818.

The type, from Veracruz (*Houstoun*!, BM), is a pale-pilose plant resembling what has been called *Conyza lyrata* var. *pilosa* Fernald, Proc. Am. Acad. 36: 506. 1901 (Chiapas, *Seler* 1879!, GH, the type), whereas the type of *C. lyrata* H.B.K. (Guayaquil, *Humboldt & Bonpland*!, P) is much less hairy, with more conspicuous glands.

Erigeron longipes DC. in DC. Prodr. 5: 285. 1836.
Erigeron scaposum DC. in DC. Prodr. 5: 287. 1836.
Erigeron scaposum β latifolium DC. in DC. Prodr. 5: 287. 1836.
Erigeron affine DC. in DC. Prodr. 5: 289. 1836.

From Coahuila and perhaps Durango southward nearly throughout southern Mexico to Central America, variable in habit, originally described as subscapose. The leaves, especially in some parts of eastern Mexico, may be grouped toward the base of the stem, whereas in Nueva Galicia the leafy part of the stem is usually elongated and the leaves well spaced along it. I have not seen the type (*Karvinski*, s.n., at M), which is from some unknown locality in Mexico, but judging from fragments in DeCandolle's herbarium (G-DC!), it represents the same species as the other names cited above. Subscapose forms seem to be especially abundant in Oaxaca, and it may be that Karvinski's specimens came for that state. *Erigeron scaposum* and *E. longipes* were described by DeCandolle as perennials, whereas *E. affine*, the type of which was a plant with elongated leafy stems, was erroneously described as an annual. The type of *E. affine*, from near the City of Mexico (*Berlandier* 522!, G-DC), almost certainly represents a perennial species. The basal parts of the plant are much like those of *E. scaposum*, and in fact the two supposed species are essentially similar except that in *E. affine* the hairs are longer on both leaf-surfaces. The type of *E. sca-*

posum came from near Toluca (*Andrieux* 277!, G-DC), and that of β *latifolium* from near Mexico City (*Berlandier* 375!, G-DC).

Erigeron velutipes Hook. & Arn. Bot. Beech. Voy. 434. 1841.
Erigeron alamosanum Rose, Contr. U.S. Nat. Herb. 1: 102. 1891.

Western Mexico, from southern Sonora (*Palmer* 348!, US, the type of *E. alamosanum*) to Chihuahua, Sinaloa, southern Zacatecas, Nayarit, Jalisco, and Michoacán. The type (*Sinclair s.n.*!, at K) was collected between San Blas and Tepic. Plants of *E. velutipes* have often been misidentified with *Erigeron tenellum* DC. in DC. Prodr. 5: 288. 1836, the type of which came from Matamoros, Tamaulipas. (*Berlandier* 2129! in G-DC, lectotype). *E. tenellum,* like *E. velutipes,* is a slender branched annual, but the herbage is eglandular and the base of the plant is only moderately stiff-hairy. The name *E. alamosanum* was based on specimens a little larger than average for the species. Similarly vigorous plants are not infrequent along the Pacific Slope from Sonora to Nayarit.

Eupatorium albicaule Sch. Bip. ex Klatt, Leopoldina 20: 89. 1884.
Eupatorium albicaule var. *laxius* Rob. Proc. Am. Acad. 35: 330. 1900.
Eupatorium leucoderme Rob. Proc. Am. Acad. 41: 274. 1905.
Eupatorium ymalense Rob. Contr. Gray Herb. II. 75: 14. 1925.

Lowlands, sea-level to 300 m. in elevation, Sinaloa (Ymala, *Palmer* 1474!, GH, type of var. *laxius* and of *E. ymalense*), Nayarit, Jalisco, Colima, Michoacán (Chuta, *Langlassé* 183!, GH, type of *E. leucoderme*); Tabasco and Chiapas; Yucatán Peninsula; north to Veracruz (Papantla, *Liebmann* 88!, P, an isotype), San Luis Potosí, and Tamaulipas. This geographical range is like that of many other species of tropical Mexico; see the maps in *Arboles Tropicales de México,* by Pennington & Sarukhán (published by

the Instituto Nacional de Investigaciones Forestales, and the FAO, pp. vii, 413. México, 1968).

Plants growing in western Mexico were distinguished from the original *Eupatorium albicaule,* first as the var. *laxius* and later as an independent species, *E. ymalense.* The only significant difference between the two populations seems to lie in the shape of the phyllaries, which are acute or attenuate in the plant of the Pacific lowlands, and usually, but not always, blunt or subacute in the plant of eastern Mexico and the Yucatán Peninsula. Robinson reported the heads in *E. albicaule* as "about 7 or 8-flowered", but they are usually 10-13-flowered, as in the supposed *E. ymalense.*

Eupatorium collinum DC. in DC. Prodr. 5: 164. 1836, var. **collinum.**

Eupatorium stillingiaefolium DC. in DC. Prodr. 5: 160. 1836.

This variety appears to be restricted to eastern Mexico. The type (*Berlandier* 2162! in G-DC), from near Tantoyuca in the Atlantic lowlands of Veracruz, apparently does not differ significantly from the type of *E. stillingiaefolium* (*Berlandier* 2142! in G-DC), which was collected in Tamaulipas. In these plants, and in modern specimens from the same region, the phyllaries are narrow and attenuate or acute (the middle ones 1 mm wide), often nearly all equal, sparingly ciliate, evidently resinous-dotted and more or less densely short-pubescent, but scarcely if at all arachnoid-tomentose. In a second variety ranging widely through central and western Mexico into Central America, the plants are more pubescent and less conspicuously glandular, the phyllaries are more strongly graduated, and some or all of them obtuse and evidently closely fimbriate-ciliate. I can detect no great variation within the limits of this second population, except that rather densely pilose individuals seem to be more frequent in Chiapas and Central America than from Guerrero westward. The second variety is the following:

Eupatorium collinum DC., var. **mendezii** (DC) McVaugh, comb. nov.

Eupatorium mendezii DC. in DC. Prodr. 5: 160. 1836.
Eupatorium neaeanum DC. in DC. Prodr. 5: 160. 1836.
?*Eupatorium nigrescens* Hook. & Arn. Bot. Beech. Voy. 297. 1838.

Sonora to Jalisco, Guanajuato (León, *Mendez*!, in G-DC, the type), Morelos, Guerrero (Acapulco, *Née*!, in G-DC, type of *E. neaeanum*), Oaxaca, Chiapas and Central America.

DeCandolle grouped *E. neaeanum, E. mendezii* and *E. stillingiaefolium* with other species having the heads 25- 30-flowered, but *E. collinum* was described as having the heads 50-flowered, and accordingly was not closely associated with the others in the *Prodromus.* I suspect that some error was involved here, although Robinson (in the *Trees and Shrubs of Mexico,* p. 1448) states that the heads in *collinum* may have as many as 46 flowers. The number of flowers usually varies from 22 to 28; it is rarely as low as 18 or 20, and even more rarely 30 or more; I have seen only one specimen in which the heads were about 36-flowered, and none with a larger head.

Robinson separated *E. collinum* from *E. mendezii* and *E. neaeanum* partly on the basis of pubescence and leaf-shape. The latter seems quite useless as an indicator of specific lines in this group of species. Pubescence in the group is highly variable, as noted above, but the types of *E. mendezii* and *E. neaeanum* are not strongly pubescent in comparison with other specimens from central and western Mexico, and the differences between them and typical *collinum* are no more than might be expected of regional populations in one species.

Eupatorium hebebotryum (DC.) Hemsl. Biol. Centr. Am. Bot. 2: 95. 1881.

Critonia hebebotrya DC. in DC. Prodr. 5: 141. 1836.
Hebeclinium tepicanum Hook. & Arn. Bot. Beech. Voy. 434. 1841.

Eupatorium tepicanum (Hook. & Arn.) Hemsl. Biol. Centr. Am. Bot. 2: 101. 1881.

Nayarit (Tepic, *Sinclair*!, K, type of *H. tepicanum*), Jalisco, Michoacán, Morelos, Guerrero (*Haenke*!, in G-DC, the type probably from this state); Central America. The distinctions used to separate the two supposed species, namely that between sessile and pedicellate heads, and that in the color of the dried leaves, appear to be inconsequential.

Eupatorium ovaliflorum Hook. & Arn. Bot. Beech. Voy. 297. 1838.

Eupatorium bertholdii Sch. Bip. in Seem. Bot. Voy. Herald 299. 1856.

Southern Sonora, ? western Durango ("Sierra Madre", *Seemann* 2011! at K, isotype of *E. bertholdii*), Sinaloa, Nayarit (Tepic, *Beechey*!, at K, the type), Jalisco, Michoacán.

According to Robinson (in *Trees and Shrubs of Mexico*, p. 1433), *Eupatorium bertholdii* is distinguished from *E. ovaliflorum* by having the heads 10- to 13-flowered and the involucre 2-2.6 mm thick, as against heads 20- to 40-flowered and the involucre 4-5 mm thick. In the material at hand these differences seem not to hold; I have not seen any head with more than 22 flowers, and none as much as 4 mm thick. The flowers are usually about 17-20, and the involucre 2.5-3 mm thick.

Eupatorium polybotryum DC. Prodr. 5: 174. 1836.

Nothites ovatifolia DC. in DC. Prodr. 5: 187. 1836, not *Eupatorium ovatifolium* Hieron., 1908.

Ophryosporus ovatifolius (DC.) Hemsl. Biol. Centr. Am. Bot. 2: 79. 1881.

Eupatorium petraeum Rob. Proc. Am. Acad. 41: 275. 1905.

Ophryosporus petraeus (Rob.) Rob. Contr. Gray Herb. II. 75: 4. 1925.

Decachaeta ovatifolia (DC.) King & H. Rob. Brittonia 21: 282. 1969.

Southeastern Jalisco, western Michoacán, Edo. de México,

Guerrero (*Langlassé* 565!, GH, type of *E. petraeum*). A related species ranging from western Michoacán northwestward to Sinaloa and Chihuahua is *Eupatorium scabrellum* Rob. Proc. Am. Acad. 35: 339. 1900 [*E. microcephalum* A. Gray, Proc. Am. Acad. 21: 384. 1886, not of Regel; *Ophryosporus ovatifolius* sensu Rob. in Standl. Contr. U.S. Nat. Herb. 23: 1469. 1926, not *Nothites ovatifolia* DC.]. *E. scabrellum* and *E. polybotryum* are separable as follows:

1. Phyllaries 12-15, 2- 4-seriate, the outer gradually shorter, the innermost (2-5 in each head) longer and narrower than the others and completely or partially modified into pales, deciduous with the achenes or before; flowers (7-) 10-12 (-15). .... *E. polybotryum.*
1. Phyllaries 6-8 in 1-2 nearly equal series (in addition to 2-3 smaller outer bracts), the innermost neither prolonged and resembling pales, nor deciduous; flowers 4-9. .... *E. scabrellum.*

The nomenclature of these species has become confused. In the *Trees and Shrubs of Mexico,* Robinson (1926, p. 1469) took up the name *Ophryosporus ovatifolius* but misapplied it to the species correctly known as *Eupatorium* [*Ophryosporus*] *scabrellum,* at the same time recognizing as independent species *O. scabrellus* (Rob.) Rob. and *O. petraeus* (Rob.) Rob. Robinson said of his *Ophrysporus ovatifolius,* "Typical material of this species, early collected by Haenke in Mexico but without indication of locality, has never been precisely matched except by specimens collected by Seemann, also without recorded locality". Presumably Robinson referred to two collections studied by him at the Gray Herbarium; the Seemann collection is the type of *Eupatorium microcephalum* A. Gray (= *E. scabrellum* Rob.). The Haenke specimen consists of a few heads and the tip of a branch of an inflorescence, annotated by Gray as "*Nothites ovatifolia* DC.!", and by Robinson as *Eupatorium polybotryum* DC. [i.e. *Ophryosporus ovatifolius*

of Robinson's treatment in 1926]. Unfortunately Robinson seems to have misinterpreted this fragment, which certainly represents *Eupatorium petraeum*, not *E. microcephalum*. The heads are only 7- 8-flowered, but the involucre is several-seriate, and the narrow paleaceous inner phyllaries are unmistakably those of "*E. petraeum*". The original Haenke specimens at G-DC, the types of *Eupatorium polybotryum* and *Nothites ovatifolia*, respectively, I have seen through the courtesy of Prof. J. Miège. These represent one and the same species, as Robinson long ago suggested, but that species is "*Eupatorium petraeum*", not *Ophryosporus ovatifolius* in the sense of Robinson. Both the Haenke collections represent a species with 12-15 graduated phyllaries of which the inner are deciduous at maturity; with 1-3 narrow pales on the receptacle; and the flowers 8-11 in each head.

King and H. Robinson (1969) first formally combined *Eupatorium polybotrium* [sic] and *Nothites ovatifolia*, under the name *Decachaeta ovatifolia*. The correct epithet for the combined taxa is therefore *ovatifolia* except in *Eupatorium* where the name is preoccupied.

Gnaphalium canescens DC. in DC. Prodr. **6**: 228. 1838.
Gnaphalium wrightii A. Gray, Proc. Am. Acad. **17**: 214. 1882.

There seems to be no significant difference between the plants of nothern Mexico and southwestern United States that have been called *G. wrightii* (western Texas, *Wright* 394!, the type), and the plants of central Mexico, from Durango and Aguascalientes to Jalisco, Guanajuato, Hidalgo and the Valley of Mexico, that have been called *G. canescens* (León, *Méndez*!, in G-DC, the type). The leaves in this species tend to be broadest near the middle or above. A very similar species is *Gnaphalium roseum* H.B.K. Nov. Gen. & Sp. 4 [ed. fol]: 63. 1818, in which the leaves tend to be oblong or broadest at base. The type (from Guanajuato, *Humboldt & Bonpland*!, P), is a coarse woolly plant with immature heads.

Gnaphalium inornatum DC. in DC. Prodr. **6**: 225. 1838.

This species was based upon four collections made by Berlandier, viz. no. 1195 ("ad montem de Las Cruces"), no. 740 (from the Valley of Mexico), no. 309 (between Tampico and Real del Monte) and no. 1146 (from Guchilaque, between Mexico and Cuernavaca). DeCandolle described it as a woolly plant with narrow erect shortly decurrent leaves, pale reddish ("refescentibus") phyllaries, about 10 hermaphrodite flowers and 30-40 pistillate flowers.

Judging from the specimens in the Prodromus herbarium (cf, also IDC microfiche 1066), and from duplicates (at P) of all the cited numbers, it seems that three different species are represented by the syntypes of *G. inornatum.* The description in the protologue does not exactly fit any of the species. Nos. 1146 and 1195 apparently represent the same species, in which the number of flowers in a head is 100 or more and the perfect flowers are 7-11 or more. DeCandolle's report of 10 perfect flowers presumably was based on one of these specimens, and one of them may appropriately be designated as lectotype. No. 740 may be eliminated from consideration as the heads are about 50-flowered, and the perfect flowers are 4 in number. DeCandolle's specimen is so immature that it seems unlikely that he dissected a head (cf. Field Mus. neg. 28713). The remaining syntype, no. 309, seems to represent a third species, also one in which the heads are about 50-flowered and the perfect flowers about 5.

Berlandier 1146 is designated as lectotype since in the Prodromus herbarium it appears to be a somewhat better specimen (than no. 1195); since from the position of specimens in the herbarium it seems to have been the one on which DeCandolle's report of 10 perfect flowers was based; and since from Berlandier's notes it appears this collection was more widely distributed than his no. 1195.

Gnaphalium sphacilatum H.B.K. Nov. Gen. & Sp. 4[ed. fol.]: 67. 1818.

Gnaphalium pedunculosum I. M. Johnst. Contr. Gray Herb. II. **68**: 99. 1923.

Durango (*Palmer* 411! in GH, the type of *G. pedunculosum*), northern Jalisco, San Luis Potosí, D.F., Edo. de México (Teotihuacán, *Hahn;* beween the City of Mexico and Huehuetoca, *Humboldt & Bonpland*!, the type, at P). Similar, narrow-leaved plants with uniformly gray thin tomentum occur in various other areas both in North and South America, and have been called by various other names, either treated as distinct species or as varieties of *Gnaphalium purpureum.* The type of *G. sphacilatum* is an immature but otherwise typical plant with the characteristic bracts, pappus, glabrous acute phyllaries, and linear thinly silky leaves.

Gnaphalium stramineum H.B.K. Nov. Gen. & Sp. 4[ed. fol]: 66. 1818.
Gnaphalium chilense Spreng. Syst. Veg. 3: 480. 1826.
Gnaphalium sprengelii Hook. & Arn. Bot. Beech. Voy. 150. 1833.
Gnaphalium berlandieri DC. in DC. Prodr. 6: 223. 1838.

Material from central and eastern Mexico can usually be distinguished from California specimens of *Gnaphalium "chilense"* because of the somewhat narrower leaves and the tendency for the uppermost leaves to become bracteiform. The types of *G. stramineum* (between Morán and Omitlán, *Humboldt & Bonpland*!, at P), and *G. berlandieri* (D.F., *Berlandier* 471!, in G-DC) are representatives of the Mexican population. The Humboldt & Bonpland specimens were apparently badly wilted before drying, and perhaps taken originally from slender or starved plants, but the heads have the characters of this species (flowers 175 or more, hermaphrodite flowers 15-16, phyllaries obtuse, the inner ones about 23). An isotype at Paris (*Bonpland* 4108) seems clearly to represent the same taxon. The characteristic yellow color of the phyllaries can no longer be seen in the original material of *G. stramineum.*

Gnaphalium viscosum H.B.K. Nov. Gen. & Sp. 4[ed. fol.]: 64. 1818.
Gnaphalium hirtum H.B.K. Nov. Gen. & Sp. 4[ed. fol.]: 64. 1818.

?*Gnaphalium gracile* H.B.K. Nov. Gen. & Sp. 4[ed. fol.]: 65. 1818.

Gnaphalium tenue H.B.K. Nov. Gen & Sp. 4[ed. fol.]: 65. 1818.

Gnaphalium leptophyllum DC. in DC. Prodr. 6: 226. 1838.

A plant primarily of the Central Plateau of Mexico, widely distributed from western Texas to northeastern Sonara, south at moderate elevations except in the extreme deserts to Oaxaca and Central America. Cronquist (in Vasc. Pl. Pacific N.W. 5: 204. 1955; and Man. Vasc. Pl. N.E. U.S. & Can. 737. 1963) has applied the name *Gnaphalium viscosum* very broadly, so as to include the plant of temperate North America that has been better known as *G. decurrens* Ives, or *G. macounii* Greene. This seems to be unrealistic; *G. viscosum* has a characteristic Texano-Mexican range distinct from that of *G. macounii* and, compared with other currently accepted species of *Gnaphalium*, it is morphologically very distinct. It differs from *G. macounii* vegetatively in its far more numerous and narrower leaves. The inner phyllaries in *G. macounii* are usually about 21, the flowers fewer (125-150 in a head) but often larger than those of *G. viscosum.* At least until the complex of glandular, decurrent-leaved fragrant species of *Gnaphalium* can be revised as a whole, *G. viscosum* may well be circumscribed narrowly. Nothing exactly referable to *G. macounii* has been found in Nueva Galicia, but numerous collections from the Sierra Madre Oriental suggest that *G. macounii* ranges well south into eastern Mexico. In Chihuahua *G. viscosum* may be confused with *G. leucocephalum* A. Gray, in which the phyllaries are pearly white, relatively dull and opaque and symmetrically graduated in length.

This is the only Mexican species having the herbage strongly glandular-pubescent throughout, the leaves very numerous (100 or more in well developed plants) and linear or narrowly sagittate, the flowers 200 or more in a head, the mature receptacle 3-4 mm wide, and the plants strictly annual, not forming a basal rosette. The types of *G. viscosum, G. hirtum, G. tenue* and *G. leptophyllum* seem

without question to represent the same taxon. The type of *G. gracile* (Guanajuato, *Humboldt & Bonpland*! at P) is apparently from a weak, depauperate plant with relatively few leaves and numerous heads.

Heterotheca inuloides Cass., var. **rosei** Wagenknecht, Rhodora 62: 69. 1960.

Heterotheca leptoglossa DC. in DC. Prodr. 5: 317. 1836.

In Wagenknecht's revision, *Heterotheca leptoglossa* is maintained as a distinct species, distinguished from *H. inuoides* by "its annual habit, narrow leaves, smaller capitular [sic], and linear phyllaries". The type of *H. leptoglossa* (León, *Méndez*!, in G-DC and cf. Intern. Doc. Center microfiche, Prodromus herbarium, no. 857), is the upper part of what appears to be a vigorous plant of *H. inuloides*, with leaves normal for that species. As many plants of *H. inuloides* flower the first year, the differences between annual and perennial habit in this group are of questionable significance. In the type of *H. leptoglossa* neither phyllaries nor ligules are atypical of *H. inuloides*. The ligules are not linear as described by DeCandolle but oblanceolate, 2.5 mm wide by 10-11 mm long. The heads are of about average size for *H. inuloides*, and the phyllaries are not unusually narrow.

Montanoa ["Montagnaea"] **karvinskii** DC. in DC. Prodr. 5: 565. 1836.

Montanoa olivae Sch. Bip. ex. K. Koch, Wochenschr. Gaertn. 7: 406. 1864.

Montanoa gracilis Sch. Bip. ex K. Koch, Wochenschr. Gaertn. 7: 407. 1864.

Montanoa subtruncata A. Gray, Proc. Am. Acad. 22: 424. 1887.

?*Montanoa affinis* Blake, Contr. U.S. Nat. Herb. 22: 612. 1924.

A common and widely distributed plant, from Sinaloa to Jalisco, Guerrero and Oaxaca, easily recognized by the wingless petioles, the glabrous lobes and throat of the disk-flowers, and the pilose anthers. It was long known

as *M. subtruncata,* until Blake (Contr. U.S. Nat. Herb. **26**: 246. 1930) confirmed the identity of that plant with *M. olivae* and *M. gracilis.* After examination of the type of *M. karvinskii* (without locality, *Karvinski s.n.* in G-DC), I can confirm Blake's tentative suggestion that this is a still older name applying to the same species. Apparently the plant called *M. affinis* is merely a nearly glabrous form of the same species.

Oxypappus scaber Benth. Bot. Voy. Sulph. 118. 1845.

Chrysopsis scabra Hook & Arn. Bot. Beech. Voy. 434. 1841. not *C. scabra* Ell., ?1823.

Pectis seemannii Sch. Bip. in Seem. Bot. Voy. Herald 309. 1856.

Oxypappus seemannii (Sch. Bip.) Blake, Contr. U.S. Nat. Herb. **26**: 261. 1930.

The name *Oxypappus scaber* was a new combination based on the illegitimate name *Chrysopsis scabra* Hook. & Arn. According to the International Code of Botanical Nomenclature (Art. 72) such a combination is not to be rejected, but is to be treated as a new name. See also above under *Archibaccharis hieraciifolia.*

Tragoceros americanus (Mill.) Blake, Contr. U.S. Nat. Herb. **26**: 240. 1930.

Calendula americana Mill. Gard. Dict. ed. 8. *Calendula* no. 10. 1768.

Tragoceras schiedeanum Less. Linnaea **9**: 269. 1834.

The original material of *Calendula americana* was sent to Miller from Veracruz by William Houstoun, between 1729 and 1733. Blake (1930) reported, after examination of the type, that it represented what had been called *Tragoceros microglossus* DC. (DC. Prodr. 5: 533. 1836), a rather local species of Jalisco and Guanajuato. According to Torres, however (Brittonia **15**: 290-302. 1963), the only species of *Tragoceros* known from the Atlantic lowlands of Mexico is the one called *T. schiedeanus.* The most easterly localities known for *T. microglossus* (*T. "americanus"*) are more than 500 km from Veracruz, in quite a different

vegetational zone. It seemed highly unlikely that a distinctive inland species like *T. microglossus* should have been found near Veracruz about the year 1730, but never have been recollected there. In April, 1970, therefore, I reexamined the type of *Calendula americana* (*Houstoun*, at BM). It is true, as Blake remarked, that the heads are sessile or practically so, as in *T. microglossus*, but the ligules of the ray-flowers are the narrow, tapering and conspicuously bifid ones of *T. schiedeanus*, not the obtuse or barely emarginate ones of *T. microglossus*. As such bifid rays occur in this genus only in *T. schiedeanus* and the related *T. zinnioides* (which has larger heads), there can be little doubt that the Houstoun specimen represents what has been called *T. schiedeanus*. It is therefore unfortunately necessary to use the name *T. americanus* for this species, and relegate the well-known *T. schiedeanus* to synonymy.

The original spelling of the generic name was *Tragoceros*, and according to the International Code of Botanical Nomenclature this spelling must be kept, although various authors have changed it to *Tragoceras* in an attempt to conform to the spelling of the classical Greek word for horn, from which the *-ceros* part of the name was derived. The Code recommends (Rec. 75A) that names ending in *-ceras* be treated as neuter in the future, but this does not affect names already published, and in no way authorizes anyone to alter the original spelling of any such name. There is ample biological precedent for names ending in *-ceros* (not *-ceras*), as pointed out by Bentham a century ago (Gen. Pl. 2, pt. 1: 356. 1873). Such names as *Anthoceros* and *Rhinoceros* have been consistently treated as masculine since the time of Linnaeus. *Tragaceros* has been used in its original form by some authors (e.g. Hemsley and Asa Gray), who have treated it as masculine. Others (notably Lessing, DeCandolle and most recently Torres) who have used the *-ceras* spelling have treated the name as neuter. There would seem to be no justification for this latter course under the Code, and the neuter forms of

specific epithets published under *Tragoceras* are to be treated as orthograhic errors.

Trigonospermum adenostemmoides Less. Syn. Gen. Comp. 214. 1832.

Since the appearance of the note on this species by McVaugh and Laskowski (Contr. Univ. Mich. Herb. 9: 498-500. 1972) I have seen the type of the name, through the courtesy of the Director of the Institut für Systematische Botanik und Pflanzengeographie of the Martin Luther University, Halle (HAL). The specimen bears Schiede's original label: "Composita. Herba annua caule ultraorgyali. Jun. 29", and an annotation in the hand of Lessing: "Trigonospermum n[.] g[.] adenostemoides n[.] sp [.]" The ample fruiting and flowering specimen clearly represents the taxon treated as *T. adenostemmoides* in our paper cited above.

Vernonia triflosculosa H.B.K. Nov. Gen. & Sp. 4[ed. fol.]: 31. 1818.

Vernonia barbinervis Sch. Bip. in Seem. Bot. Voy. Herald 297. 1856.

Vernonia (?) *palmeri* Rose, Contr. U.S. Nat. Herb. 1: 101. 1891.

Vernonia chacalana Blake, Contr. Gray Herb. II. 52: 19. 1917.

Southern Sonora (*Palmer* 387!, at US, type of *V.(?) palmeri*), Sinaloa, Durango (Chacala, *Goldman* 333!, at GH, type of *V. chacalana*), Nayarit, Jalisco, Colima, Guerrero (Acahuizotla, *Humboldt & Bonpland*!, the type); Central America. The type of *V. barbinervis* (*Seemann* 1998!, at P), came from the "Sierra Madre", i.e. probably from Durango, Sinaloa, or northern Nayarit.

According to both Gleason and Blake, *Vernonia palmeri* is a distinct species ranging from Sonora to Tepic, characterized by the (usually) relatively abundant pubescence of the lower leaf-surface. *Vernonia barbinervis*, known only from the type-region, has the foliage almost glabrous except that the leaves are densely tomentose along the

midvein beneath. In typical *Vernonia triflosculosa,* supposed to range from Colima to Costa Rica, the leaves are said to be glabrous to "thinly tomentulose" beneath. Both glabrous- and pubescent-leaved plants occur in Nueva Galicia, but I do not find any other features correlated with differences in pubescence, and I believe only one species can be recognized.

Viguiera puruana Paray, Bol. Soc. Bot. Méx. 22: 4. 1958.
Viguiera blakei McVaugh, Contr. Univ. Mich. Herb. **9:** 454. 1972.

My attention was called to the similarity between *Viguiera puruana* and *V. blakei* by a specimen collected in Michoacán (6 km south of Tuxpan on the road to Zitácuaro, *Rzedowski* 25153, MICH) and correctly identified as *V. puruana.* Since then, through the kindness of Dr. Ramón Riba y Nava Esparza, I have seen the type of *V. puruana* (Michoacán, San José de Purúa, *Paray* 1780, MEXU). There can be no doubt it represents the taxon more recently described under the name of *V. blakei.*

Xanthocephalum sericocarpum A. Gray, Proc. Am. Acad. **15:** 31. 1879.

Two very similar species have long been confused under this name. One is a perennial of arid grasslands and their borders, ranging from Querétaro and San Luis Potosí to northern Jalisco and the plains near the City of Durango. The other is an annual, chiefly of pine forests, from western Chihuahua to Aguascalientes and northern Jalisco. The ranges of the two overlap, as far as known, only in Aguascalientes and Jalisco:

1. Phllaries 16-18 (-25); disk-flowers commonly about 80-85; plants perennial, from a woody taproot. . . . . *X. sericocarpum.*
1. Phyllaries 35-50; disk-flowers 100-200; plants annual. . . . . *X. conoideum.*

The type of *X. sericocarpum* (San Luis Potosí, *Parry & Palmer* 369!, GH) evidently represents the perennial species. The heads are small, the phyllaries 20-25, broad

and relatively firm (not lanceolate or narrowly rhombic with broad hyaline margins as in *X. conoideum*). A collection by Schaffner, mounted on the type-sheet by Gray, apparently represents the same species.

The annual species is *X. conoideum* Hemsl. Biol. Centr. Am. Bot. 2: 110. 1881. The type (*Coulter* 299!, at K) was collected somewhere in central Mexico, "between Real del Monte and Zacatecas".

Zinnia bicolor (DC.) Hemsl. Biol. Centr. Am. Bot. 2: 153. 1881.

Mendezia bicolor DC. in DC. Prodr. 5: 533. 1836.

Zinnia tenella Rob. Proc. Am. Acad. 63: 39. 1907.

Western Chihuahua, Durango (Tejamen, *Palmer* 500!, at GH, type of *Z. tenella*), southern Zacatecas, northern and eastern Jalisco, Guanajuato (León, *Méndez*! in G-DC, the type), San Luis Potosí.

The ligules of the ray-flowers are white or yellow (the two colorforms sometimes mixed in the same population), or yellow with a red spot at base. A plant with yellow ligules red-spotted at base formed the basis for *Z. tenella*. According to Torres *Z. tenella* differs from *Z. bicolor* also in having "lanceolate to elliptic" rather than "linear to lance-oblong" leaves, and "obovate to cuneate" rather than "linear-elliptic" ray-achenes. In Nueva Galicia the differences in leaf-shape, in achene-shape, and in ray-color, appear to represent individual variations, and it seems futile to try to distinguish more than a single species in the group.

Zinnia violacea Cav. Ic. 1: 57. *pl. 81.* Dec 1791.

Zinnia elegans Jacq. Ic. P1. Rar. 3: 15. *pl. 589.* 1793; Coll. Bot. 5: 152. 1797.

Essentially all authors have taken up the name *Zinnia elegans* in preference to *Z. violacea*. The place of publication of *Z. elegans* was correctly cited by a few contemporary authors, as by Willdenow (Sp. Pl. 3, pt. 3: 2140. 1803) and by Sims (in Bot. Mag. *pl. 527.* 1801). In DeCandolle's revision of the Compositae, however, through a typo-

graphical error the reference was given as "Jacq. Coll. 3. p. 152" (DC. Prodr. 5: 536. 1836). This error has been perpetuated by subsequent authors who have merely copied from DeCandolle without looking up the original reference. Thus in Hemsley's treatment of *Zinnia* in the *Biologia Centrali-Americana,* and in the *Index Kewensis,* the citation is of volume 3 of the *Collectanea,* not volume 5. As volume 3 was published late in 1791 (cf. Stafleu, F., *Taxonomic Literature,* p. 232. 1967) it may well have enjoyed priority over the first volume of Cavanilles' *Icones,* which appeared in December of the same year. The fifth volume of the *Collectanea,* however, did not appear in print until 1797 . It seems clear that the name *Zinnia violacea* Cav. has priority of more than a year over *Z. elegans* Jacq., which was published first in 1793 and again in 1797.

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THE COMBINATION *PELTANDRA VIRGINICA* (L.) SCHOTT & ENDLICHER: The indigenous eastern North American genus *Peltandra* was described by Rafinesque (J. Phys. Chim. Hist. Nat. Arts 89: 103, 1819) when he based it on a simultaneously described new species, *P. undulata* Raf. in a somewhat confusing manner, Rafinesque states that *"Calladium sagittaefolium"* (= *Arum sagittaefolium* L., a member of the genus *Xanthosoma* according to Fernald, Rhodora 50: 59, 1948) and *"C. virginicum"* (presumably = *Arum virginicum* L.) are related to *Peltandra,* but he apparently did not intend their inclusion in the genus. Rafinesque (New Flora and Botany of North America 1: 87, 1836) later conceded that *P. undulata* was probably identical to *Arum virginicum.* However, he re-

tained the name *P. undulata,* failing to employ the correct combination *P. virginica.* Index Kewensis wrongly attributes the combination *P. virginica* to Rafinsque.

Most authors who have dealt with *Peltandra virginica* credit the name to Kunth (Enumeratio Plantarum 3: 43, 1841). Included in this list are: Morong (Mem. Torrey Bot. Club 5: 102, 1894), Tidestrom (Rhodora 12: 48, 1910), Blake (Rhodora 14: 104, 1912), Small (Manual of the Southeastern Flora 246, 1933), Barkley (Madroño 7: 133, 1944), Gleason (New Britton and Brown Illustrated Flora 1: 368, 1952), Huttleston (Taxon 2: 33, 1953), Fassett (A Manual of Aquatic Plants, second ed., 164, 1957), and Radford *et al.* (Manual of the Vascular Flora of the Carolinas 257, 1968). On the other hand, Fernald (Rhodora 50: 56, 1948; Gray's Manual of Botany, eighth ed., 383, 1950) and Merrill (Index Rafinesquianus 81, 1949) recognize Scott and Endlicher (Meletemata Botanica 19, 1832) as having made the combination. Clearly, authorship of this combination is a point of nomenclatural confusion.

A study of the original literature of concern revealed that the combination *Peltandra virginica* was first used in print by Steudel (Nomenclator Botanicus 1: 603, 1821) when he mistakenly attributed the combination to Rafinesque. Steudel should not receive credit for a new combination in this instance as he considered *P. virginica* a member of the genus *Arum,* indicating it as a synonym of *Arum virginicum.* The only species accepted by Steudel as belonging to *Peltandra* is *P. undulata.* Steudel (Nomenclator Botanicus, second ed., 1: 249, 1840) later discontinued recognition of the genus *Peltandra* and included it in the synonymy of *Caladium.* Merrill (1949) notes Steudel's (1821) use of the name *P. virginica* and rightly does not credit him with the combination. Schott and Endlicher (1832) accord *Peltandra* generic status and accept *P. undulata* and *P. virginica* as distinct species, attributing both names to Rafinesque. Kunth (1841) cites Schott and Endlicher's treatment and similarly recognizes both species, also crediting Rafinesque with the names. At

a considerably later date, Schott (Synopsis Aroidearum 50, 1856) maintains the same opinion concerning the taxa of *Peltandra* and their authorship.

Although there can be little or no support for regarding *P. virginica* and *P. undulata* as distinct, Schott and Endlicher (1832) validly make the combination *Peltandra virginica* for the first time, even though they erroneously attribute the combination to Rafinesque. Fernald (1948, 1950) and Merrill (1949) are thus vindicated in their designation of authorship as *Peltandra virginica* (L.) Schott & Endlicher. By the new wording of Recommendation 46C of the International Code of Botanical Nomenclature, as proposed by Yeo (Regnum Vegetabile **60**: 62, 1969, Proposal 281) and amended and accepted by the Eleventh International Botanical Congress (see Taxon **19**: 48, 1970), the citation of authorship as *Peltandra virginica* (L.) Rafinesque ex Schott & Endlicher would be equally correct, though in my opinion less desirable since the ascription to Rafinesque is apparently a mistaken one.

I wish to gratefully acknowledge the American Philosophical Society for grant support of my current systematic investigations of the genus *Peltandra*.

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SPONTANEOUS HYBRIDS BETWEEN CERASTIUM TOMENTOSUM LINN. AND C. ARVENSE LINN.

J. K. MORTON

The "White Rock" or "Snow in Summer" of our gardens — *Cerastium tomentosum* Linn. is a native of southern Europe, now commonly cultivated as a rock garden plant throughout the temperate world. It is a very vigorous perennial which rapidly spreads and takes over the whole of the rock garden, hence its rhizomes are frequently dug up and thrown onto roadsides, river banks and rubbish dumps where it sometimes becomes established and competes successfully with the native flora. *C. arvense* Linn. is a native species in North America where the most widely occurring form is diploid. However the common European form is tetraploid (2n = 72 as in *C. tomentosum*) and has been introduced into northeastern North America where it frequently becomes a weed along roadsides, riverbanks, and in old pasture and quarries etc. Whether its introduction to this continent was deliberate or accidental is uncertain, though the former is not improbable for it makes an attractive rock garden plant, apart from its propensity to spread too vigorously.

In the mid and upper reaches of the Grand River valley in southern Ontario, both these species occur; *C. tomentosum* as a common garden plant persisting in derelict gardens and occasionally established as a garden throwout; and *C. arvense* as a well established weed on road, rail and river banks etc. Hybrids between the two species have been discovered at Fergus, Waterloo and Galt. At Fergus the hybrid plants are growing amongst concrete slabs on a grassy roadside bank at the Elora end of the town. The area probably originated as a rockery but has long been neglected, and both parent species are growing alongside the hybrids. Further plants of the hybrid occur below the road, on old ballast used in constructing the road and dumped on the river bank. At Waterloo the plant was

found in an old rockery of a long since derelict farm house, and has since been transplanted into several rock gardens in the town. Neither parent now grows in the immediate vicinity of the old farm house and the nearest colony of *C. arvense* is several miles away. At Galt the hybrid plants are growing amongst grass on cindery ground on an old rubbish tip, and in the lawn of an adjoining house on the Brantford side of the town between route 24 and the Grand River. Neither parent is growing in the immediate vicinty but *C. arvense* occurs along the Grand River about a mile distant.

The Fergus and Waterloo plants appear to be the F_1 hybrid and are intermediate between the two parents, but somewhat closer to *C. tomentosum* in general appearance, looking like a rather poorly developed plant of that species in which the white indumentum is less dense. The Galt colony apparently consists of F_2 segregates probably resulting from selfing of the F_1 hybrid. They are smaller, very variable plants and several of them are nearer to the *C. arvense* parent in general appearance.

These hybrids flower copiously and produce a number of short capsules, the teeth of which barely exceed the calyx. Most of the ovules in these abort, but frequently one or two, occasionally more, very large seeds are formed. These are fertile and the progeny show extensive segregation, ranging from close to one or other of the parents, to various combinations of characters intermediate between the parents. It is probable that these seeds result from selfings rather than pollination from either parent.

Hybrids between *C. tomentosum* and *C. arvense* are rarely encountered in Europe where the species are native and sometimes grow in close proximity. The only reference in the literature to such hybrids, that I have been able to locate, is Ascherson and Graebner 1919 where they are referred to *C. maureri* and *C. rigoi* without authority or supporting information. Neither of these names appears to have been taken up by subsequent workers, perhaps because of the very rare occurrence of this hybrid.

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AMPHIPRORA ORNATA BAILEY — A SECOND STATION IN NEW ENGLAND

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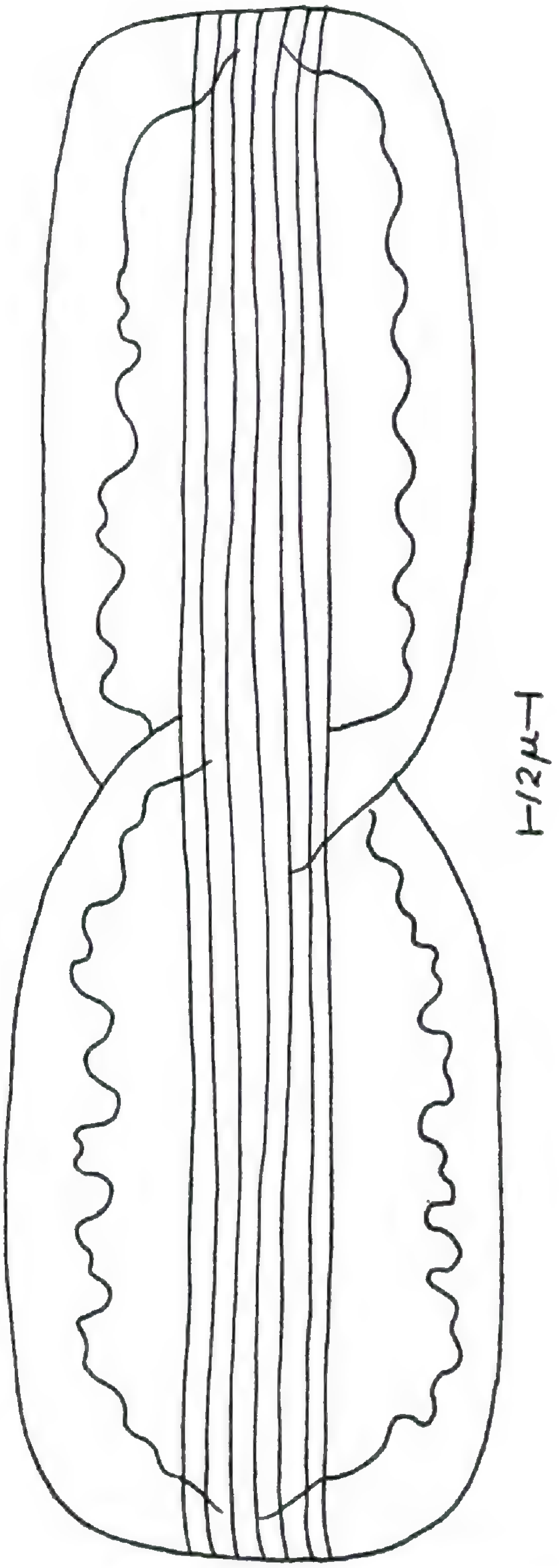
During continuing studies of the phytoplankton of the Connecticut River I collected a single specimen of *Amphiprora ornata* Bailey. As the accompanying figure shows the species is distinct enough in structure so as to make it readily recognizable.

The specimen was recovered from material taken by a vertical haul with a Wisconsin-type sampler in 46 feet of water. The collecting station is located 0.1 miles north of the dam at Vernon, Vermont. All of the stations being utilized during this study are within five miles of Vernon. The collection was made just before 12 Noon on June 5, 1970. At this time the air temperature was 68 degrees F., and the water temperature was 66 degrees F.

Although the collecting station is physically closer to Vermont than New Hampshire, ownership of the Connecticut River below high water mark is vested in the State of New Hampshire. Thus, *Amphiprora ornata* Bailey is reported for the Town of Hinsdale, Cheshire County, New Hampshire.

This appears to be only the second collection for New England. The previous station being somewhere in the vicinity of New Haven, Conn., reported by Terry (1907). Other reported stations include the type from Florida by



Amphiprora ornata Bailey. Camera lucida drawing by the author.

Bailey (1850), Boyer (1827) in Pennsylvania, and Whitford (1969) in North Carolina.

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THE YELLOW MANDARIN, A NOTABLE ADDITION TO THE FLORA OF ARKANSAS

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Although the yellow mandarin, *Disporum lanuginosum* (Michx.) Nickols, is widespread in the eastern United States, it was, according to Robert G. Johnson (personal communication), not known west of Davidson County, Tennessee, except for one record of its occurrence in Arkansas which was most likely in cultivation. Dr. E. B. Smith (personal communication) also informs me that a single specimen from Texarkana, Miller County, Arkansas, is present in the herbarium of University of Arkansas and is marked "probably cultivated." The discovery of a new locality for the yellow mandarin in Arkansas is therefore notable for two reasons. First, because of the area where it was discovered, there can be no doubt now that it is a native, though rare, member of the flora of Arkansas. Second, it adds to the growing list of southern and Appalach-

ian species present in the relic mesophytic forests common throughout the Boston Mountains (Braun, 1950). This list includes such vascular plants as *Fagus grandiflora, Liquidambar styraciflua, Magnolia tripetala* and *Lycopodium lucidulum,* and bryophytes such as *Hookeria acutifolia, Brotherella tenuirostris, Schwetschkeopsis fabronia, Sciaromium lescurii, Sphagnum capillaceum* var. *tenerum* and *Bryoxiphium norvegicum.* Except for this last species, which occurs in several nearby ravines, all of these taxa are located in the immediate vicinity of the habitat of *Disporum lanuginosum.* Another notable species in this area is *Dodecatheon frenchii.* Like *D. lanuginosum,* it also occurs along the base of a north-facing sandstone bluff; otherwise, this species is known from one other locality in Arkansas (Olah & DeFillipps, 1968) and in the Ozarks of southern Illinois (Voigt & Mohlenbrock, 1964).

The specific collection data for *Disporum lanuginosum* in the Boston Mountains of Arkansas is: Newton County. On rocky soil at base of north-facing sandstone bluff, upper reaches of Terrapin Branch, sect. 26, T. 14 N., R. 23 W., alt. ca. 700 ft., *Redfearn* 27381 (ARK, SMS, NCU, UMO).

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RHAPIDOPHYLLUM HYSTRIX IN MISSISSIPPI

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Rhapidophyllum hystrix (Pursh) Wendland & Drude, the Needle Palm, is a rare shrub of the southeastern Coastal Plain. It occurs sporadically from central Florida and southern Georgia westward to Mississippi (Small, 1923; Harper, 1928; Small, 1933). Recent field studies have extended its known distribution in Mississippi; herbarium specimens will be deposited in MISSA.

The northernmost site known in Mississippi is in Lauderdale County, approximately 10 miles south of Meridian (*Watson* 7314), where it was discovered by Leslie Hubricht. Southward, it has been found in Clarke (*Watson* 7439) and George (*Denier* 1273) counties and reaches its southern limit in Jackson County (*Watson* 7870). It extends westward to Simpson County where it was noted by R. B. Channel in the early 1960's (personal communication). A recent search of this site to obtain herbarium specimens was, however, unsuccessful. Recently it has been found in Forrest County (*Watson* 8115, October 25, 1969), approximately 60 miles east of the Simpson County locality.

Within the state, the Needle Palm is known to occur either along the flood-plains of small streams or along the drainages of rich, wooded ravines.

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EQUISETUM FROM PENINSULA FLORIDA

Don R. Reynolds and Ken Calhoun

The first report of *Equisetum* in Florida was made in 1932 when *E. praealtum* was discovered in Northern Florida (Small, 1938). *E. robustum* is recorded from 1929 growing along the Apalachicola River at Alum Bluff. Correll (1938) lists *E. praealtum* as occurring along wet sandy stream banks in Liberty County, Florida. Schaffner (1939) maps the locality of *Equisetum* in Florida as occurring in the pan-handle of the State. Wherry (1961) lists *E. hyemale* var. *elatum* as occurring in Gadston county along the Georgia border and westward to Texas. He lists the habitat as, "sandy shores and seemingly barren areas where moisture and nutrients can be found at depth. Invading disturbed soil, fills . . ." Heretofore *Equisetum* is known only from the pan-handle area of Northwest Florida. We wish to report *Equisetum* from peninsula Florida.

Two collections have been identified as *Equisetum hyemale* var. *affine,* following Hauke (1963). This determination has been confirmed by a comparison with the specimen of G. Engelmann in the Missouri Botanical Garden, St. Louis, which is the type of this variety.

SPECIMENS EXAMINED: Florida Technological University Herbarium:

8 February 1971. *Ken Calhoun and Don R. Reynolds,* Brooksville Limestone Quarry, Liberty County, Florida. The specimens were growing in moist clay in several places in the quarry. The quarry is approximately ½ mile long and 300 yards wide and 50 feet deep. It was abandoned in 1967. There was little competition from other plants for the large *Equisetum* clones which flourished along a large water filled pit that ran the length of the quarry. The area immediately surrounding the quarry and other likely areas within a 25 mile radius were searched on several

occasions. Although several apparently suitable habitats were located, *Equisetum* seems to be restricted to the confines of the Brooksville Quarry.

9 May 1971. *Don R. Reynolds and Ken Calhoun,* Sand Quarry, approximately 10 miles east of Clermont on US Highway 50, Lake County, Florida. The specimens were growing in sandy soil which was intermittently wetted from water being pumped into the quarry as part of the dredging operation. The quarry covered about one square mile; a large part was covered with water. No vegetation was growing in the immediate proximity of the *Equisetum* clone.

Hauke (1963) has demonstrated the clinal variation between the southern states of *E. hyemale* var. *affine,* based on teeth retention, height of plants and ridge angularity. The clines of Mississippi, Alabama and Northern Florida are similar to the clines of Georgia except that the percentage of teeth retention in the Georgia clines is much lower. According to the percentage of teeth retention in the two specimens cited (80-100%), the *Equisetum* from Liberty and Lake Counties represent a southerly extension of the Mississippi, Alabama, North Florida clines rather than the Georgia one.

A third collection of Horsetail was recently given to Dr. Robert Long (Biology Department, University of South Florida) which was found growing in a ditch in Dunedin, Pinellis County, Florida. Dr. Long (personal communication) identified the plants as *Equisetum hyemale.* This collection represents the southernmost record on the Florida peninsula.

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WIND AND THE WINTER-EXPOSED PLANT. In his paper "Snow Cover and the *Diapensia lapponica* habitat in the White Mountains, New Hampshire" (Rhodora 74: 358-377), W. N. Tiffney, Jr. makes repeated reference to the prevalence of high winds in the alpine zone which, in his belief, ". . . promote desiccation in winter-exposed plants". The idea that winter desiccation is significantly influenced by high winds is shared by at least one other ecologist (Lindsay, 1971), but this conclusion seems to be based on the application of summertime wind effects to the wintertime situation. The energy budget of the winter-exposed plant is, however, quite different from that of the more freely transpiring plant in a summer microclimate, and the prevalence of high winter winds may instead forestall damaging water loss.

Transpiration from a leaf surface, at any time, is directly proportional to the water vapor concentration gradient between the leaf and air, and is inversely proportional to the diffusive resistances offered by the leaf and boundary layer of air adjacent to the leaf (Gates, 1965). Hence $T = \frac{c_l - c_a}{r_l + r_a}$ where T is the transpiration rate, $c_l - c_a$ is the water vapor concentration difference between the intercellular spaces of the leaf and the bulk air outside the leaf boundary layer, and r_l and r_a are respectively the leaf and boundary resistance to gaseous transfer. It should be noted that the driving force for transpiration, $c_l - c_a$, is strongly influenced by the temperature difference between the leaf and air, since saturation vapor pressure is a function of temperature. The greater the elevation of leaf temperature above

air temperature, the greater the vapor concentration gradient between the leaf and air.

Leaf resistances to the diffusion of water vapor are provided by the stomates and cuticle, the relative magnitude of these being somewhat species dependent. The minimum stomatal resistance of the alpine species *Ledum groenlandicum* is for, example, less than 2 sec cm^{-1}, as determined for plants growing in both a northern bog (Small, 1972) and above timberline on Mt. Washington, New Hampshire (Marchand, unpublished data). The stomatal resistance of conifers may be somewhat higher, perhaps near 20 sec cm^{-1} (Waggoner and Turner, 1971). In contrast, cuticular resistance is usually several times greater in magnitude, having been reported (Holmgren et al., 1965) as high as 460 sec cm^{-1} for the European species *Quercus robur.* In addition, cuticular resistance has been found to increase sharply with decreasing temperature (Holmgren et al., 1965).

Boundary layer resistance is provided by a transfer zone of air in contact with (and influenced by) the leaf. The thinner this surrounding layer, the more rapid will be the heat convection or vapor transfer through this zone, since heat and vapor concentration gradients between the leaf and bulk air will be steeper. Single leaf boundary layer resistances have been found to be generally less than 0.9 sec cm^{-1} for several deciduous woodland species (Holmgren et al., 1965), although this will vary directly with leaf size and shape and inversely with windspeed (Gates, 1965).

It is through reduction of boundary layer resistance that the influence of wind currents is important. The effect of wind is two-fold; (1) it facilitates removal of moist air from the leaf surface, thereby increasing the rate of transpiration, and (2) it increases the rate of heat transfer from the leaf, through forced convection, thus tending to maintain temperature equilibrium between the leaf and air. In the latter case, $c_l - c_a$ is reduced and consequently transpiration is decreased. The relative importance of these two processes will depend on other microenvironmental factors as well as on the physiological behavior of the plant.

During the summer growth period, the most significant leaf resistance to loss of water (under non-stress conditions) is that of the open stomates. Cuticular transpiration is negligible as long as the stomates remain open. At this time of year then, the boundary layer resistance is closer in magnitude to the leaf resistance and any reduction of r_a by turbulent exchange becomes significant in terms of increasing transpiration. Under these circumstances, the effect of wind on leaf temperature seems to be of minor importance.

In the wintertime, the relative importance of the diffusive resistances is changed significantly. Stomatal opening has not been reported to occur during the winter (Tranquillini, 1964; Schulze et al., 1967) as apparently it is prevented by low temperatures (Staefelt, 1962). As a result, vapor diffusion is largely via cuticular pathways and the leaf resistance thus becomes very high.* It is on this point that my argument is based. As seen from the above transpiration model, when r_l is high, r_a becomes negligible and any reduction of the boundary layer resistance by high winds is unimportant in terms of increasing vapor transfer. So the dominant effect of wind in the wintertime is, in my opinion, related to the consequences of forced convection, and these are (1) maintenance of leaf temperatures below the freezing point of cell water when air temperatures are very low, and (2) reduction of temperature differences between the leaf and air with consequent reduction of $c_l - c_a$. In the first case, water loss will be limited to the process of sublimation from frozen tissues, requiring greater energy input than for the evaporation of free water. In both cases, the net effect of wind would be to reduce, rather than increase water loss.

Where reference has been made to the work of Tranquillini (1964) and Sakai (1970), citing conditions of winter drought and desiccation damage in alpine areas, it should

*The discussion here is pertinent only to evergreen species, and since heavy cutinization is characteristic of evergreens, the value of cuticular resistance is assumed to be very high relative to r_a.

be noted that such conditions are the combined result of frozen soils and the strong heating of plant parts above freezing, due to high direct and reflected radiation load on exposed plants. Thus it is most likely that winter-exposed plants will experience damaging water loss on days which are clear and windless. Whether or not winter desiccation in the alpine areas of the White Mts. of New Hampshire can be substantiated, the conclusion that ". . . low temperatures and high winds combine to promote severe desiccation in this snow-free area" seems unwarranted on the basis of simple physical considerations.

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UNIVERSITY OF NEW HAMPSHIRE
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XII INTERNATIONAL BOTANICAL CONGRESS JUNE 23-30, 1975

The Closing Plenary Session of the XI International Botanical Congress held at Seattle, U.S.A., in 1969, accepted an invitation issued by the Academy of Sciences of the U.S.S.R. to convene the XII International Botanical Congress in the City of Leningrad in 1975. In 1971 the Organizing Committee was appointed: consisting of a chairman (A. L. Takhtajan); four vice-chairmen (A. A. Prokofiev, A. A. Theodorov, N. V. Tsitsin, A. A. Yatsenko-Khmelevsky); a secretary-general (O. V. Zalensky); a scientific secretary (N. S. Snigirevskaya); and a number of members at large. The XII International Botanical Congress is intended to facilitate interdisciplinary communication among botanists as well as an informal exchange of ideas. A number of sections are planned, including special ones to accommodate mycologists (also lichenologists), phycologists, and bryologists.

The Congress will be divided between organized half-day symposia and half-day contributed paper sessions. In addition to the opening and closing plenary sessions, two evening lectures are being scheduled. All special interest groups wishing to apply for space and time during the Congress should do so by writing as soon as possible to the secretary-general, Dr. Oleg Zalensky, Komarov Botanical Institute of the Academy of Sciences of the U.S.S.R., 2, Popov Street, Leningrad 197022, U.S.S.R.

The sessions of the Nomenclature Section will take place, as usual, immediately before the opening of the Congress — in this instance June 20-23. Four days are set aside in order to enable the Section to convene for six to eight sessions of two to four hours each.

A meeting of the International Association of Botanic Gardens (President Academician N. V. Tsitsin) will be held in Moscow at the Main Botanical Garden of the Academy of Sciences of the U.S.S.R. on June 20.

A tentative schedule of scientific field trips has been

planned for the immediate pre-Congress and post-Congress periods. The principal purpose of these trips is to acquaint visiting botanists with as many interesting and unique features of the flora and vegetation of various regions of the U.S.S.R. as possible. Some specialized trips for phycologists, lichenologists, bryologists, and palaeobotanists are also planned.

The double postcards announcing the XII International Botanical Congress will be mailed during the last months of 1972. Those who wish to receive further information on the Congress should return their interest cards by March 1, 1973, so that they will be placed on the mailing list for the First Information Circular expected to be published June-July 1973.

CHAIRMAN, ORGANIZING COMMITTEE
A. TAKHTAJAN

REQUEST FOR UNNEEDED COPIES OF RHODORA FOR DECEMBER 1971, NO. 796

The error on the cover of the fourth number of Rhodora for 1971, indicating it as September 1971, no. 795, has resulted in many persons discarding it as a duplicate. Had they looked inside the cover they would have detected the error immediately. However so many requests have come in for replacements that Dr. Herman Sweet requests that any subscribers who have this December issue, and do not regularly keep a file of Rhodora, send this particular copy to him at the Botanical Museum, Oxford Street, Cambridge, Mass. 02138.

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